AN ECOLOGICAL ANALYSIS OF CHILD MALNUTRITION IN AN ABELAM COMMUNITY, PAPUA NEW GUINEA

By

Daniel Clarence Tyson

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DECLARATION

Except where otherwise indicated
this thesis is my own work.

Daniel Clarence Tyson
February 1987
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ABSTRACT

High rates of child malnutrition in the Maprik area of Papua New Guinea in conditions of apparently adequate food supply are the subject of analysis. The research methodology elucidates the processes underlying variability in nutritional status of under five year old children and in particular focuses on the child and its micro-environment and the family and its environment. Anthropometric data and estimates of dietary intake for under fives describe the nature and extent of malnutrition and its proximate causes. Toddlers (aged approximately 7-24 months) experience the highest rates of malnutrition (wasting) and this sub-group is emphasised throughout the thesis. Child-environment relations considered in detail include the pathogenic hazards experienced by children and patterns of disease management; and the Abelam child nurturing paradigm. Family-environment relationships focus on socio-economic inequality within Gwelikum village and its possible nutritional effects.

The research concludes that the processes producing early, rapid, and prolonged wasting in toddlers are not due to inadequate food production - rather, a number of inter-related phenomena in the child's micro-environment are largely responsible. It is argued that a unique Abelam "culture of nurture" has evolved in response to long exposure to high infant/toddler mortality and morbidity; in response to subsistence labour demands on women; and in response to intrinsic and seemingly insuperable food "bulk density" problems faced by these young children. The nurturing pattern was one of "benign general neglect" and was characterised by relatively low nurturing inputs to infants and toddlers until life chances improved. Post-contact changes to infant/toddler mortality patterns have improved survival.
potential but these changes have not been accompanied by a shift in the nurturing pattern - indeed the persistence of the traditional pattern may contribute to the high present day malnutrition rates.

In general, although the pathogenic and parental environments are the primary factors influencing a child's nutritional well-being, inequality between families may also contribute to differential food quality and availability between families. I conclude that families with malnourished under fives are more likely to have smaller per capita food garden areas and to participate at lower levels in the cash economy. It is concluded that lower participation in the subsistence sector by some families is due largely to socio-economic marginalisation produced by the break down in competitive exchange, and is not due to restricted access to land or planting stocks. On the other hand, an increasing perception of land shortage has led to restricted access to land for cash cropping. The contemporary subsistence sector has effectively more families operating on a "minimum subsistence needs" only basis - a subsistence strategy which may be adequate for most years but which is inappropriate for lower than normal rainfall years (as witnessed in 1983 and 1984) - a relatively common hazard in the Maprik area. High population growth rates in the future may further heighten perceptions of land shortage and may result in greater inequalities in the cash economy sector. Similarly, although population growth has had little apparent effect on subsistence yields or the condition of the physical environment so far, there is an urgent need to determine critical soil and forest fallow conditions below which subsistence viability is threatened.

Although fundamental changes to the pathogenic environment, child nurturing systems, and some aspects of the subsistence base are probably necessary to resolve most of the nutritional problems of the area, it is impractical and indeed inappropriate to propose wide ranging changes to the child nutritional system which is inextricably part of the larger Abelam society. Abelam human ecology is still poorly understood and intervention
proposals specifically directed towards remedying nutritional problems may also have unintended and possibly irreversible social and cultural effects. There is evidence of positive responses from within the village to the nutritional problems faced - it is suggested that endogenous solutions should be fostered and facilitated, but this also means re-vitalising the now moribund government extension services in the area.
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CHAPTER 1

INTRODUCTION

This thesis investigates the nutritional lives of young children in a small Abelam community of lowland Papua New Guinea. My overall objective is to provide understanding of the ultimate causes of child malnutrition,¹ in what appear to be conditions of relative food abundance. The study is problem oriented and is primarily concerned with examining processes underlying variability in child nutritional status, particularly processes in the child’s immediate environment. A further objective is to consider the application of my findings to the nutritional betterment of Abelam children.

Protein-energy malnutrition (PEM) in young children is a significant problem in Papua New Guinea, but the extent and severity of the problem varies considerably within the overwhelmingly rural, subsistence-based nation. Papua New Guinea’s population is culturally, linguistically and genetically diverse, as is the range of environmental conditions and subsistence systems. The 1978 National Nutrition Survey revealed that overall, 38 percent of under five year old children were below 80 percent of the Harvard weight-for-age standard (Lambert 1978). This represented approximately 187,000 malnourished under fives.

Children under five years of age generally attract most research and intervention efforts. Malnourished younger children are more likely to get sick and have a higher probability of death (Heywood 1981). Determining the appropriate level of malnutrition at which increased morbidity and mortality risk is significant in public health terms is important at the national level as

¹"Malnutrition", in this thesis refers to inadequacy of nutrients for proper body growth and functioning rather than an excess intake of nutrients.
it has short-term and long-term economic and development implications. Thus, child malnutrition is both a health and development issue.

Parts of the Maprik district are among the most densely populated lowlands districts in Papua New Guinea (King 1982:20) with land shortages, environmental degradation, malnutrition, and socio-cultural disruption perceived as problems of long standing. These issues have also been the subject of academic and government attention (Forge 1963; Lea 1964; Oxer 1965; Whiteman 1965; Ross 1984). The district has some of the highest child malnutrition rates in the nation (Heywood 1985). My initial focus on the Maprik area arose out of discussions with Dr. Peter Heywood, Deputy Director of the Papua New Guinea Institute of Medical Research (IMR). Although the Maprik area’s nutritional problems had been recognised for many years, most of the more recent Papua New Guinea nutrition research had been conducted in the highlands in sweet potato-pig subsistence systems. Yam-banana-sago systems were not well represented in the literature. Furthermore, the Maprik district was a significant lowlands coffee producing area. A “cash cropping causes malnutrition” debate existed (and is still unresolved) at the time of site contemplation so Maprik was an ideal location to examine this issue.

1.1 Theoretical considerations

An extensive pre-fieldwork literature survey of nutrition research in Papua New Guinea revealed a diverse range of hypotheses and explanations for child malnutrition. My broad thesis aims demanded an inclusive, integrated methodology and this is best exemplified by the human ecology or people-environment tradition in geography. I had formed a number of a priori assumptions about the likely causes of child malnutrition including the probable variable nature of the resource base, variable access to it, the degree to which resources are used, the degree of participation in the cash economy, the differential health status of individuals, inter-personal relationships within
families, food beliefs, random or unexpected events, and series of events or stresses on individuals, families or the whole community. I hypothesised that most phenomena or traits were variable and unequally shared within the community, and that inequality of these traits would explain malnutrition in under fives.

This thesis is essentially empirical and problem oriented. The human ecology framework is an ideal vehicle for a necessarily integrated research problem but I have used the model more as a methodological “coathanger” than as a prescription for a rigid application of a systems approach.

Parallel human-environment research traditions have long existed in human geography and anthropology (Grossman 1977). Mikesell (1969:232) regarded the two disciplines as being “...like brothers separated in infancy and taught to speak separate languages”. Within anthropology the tradition is expressed under a number of headings: “cultural ecology” (Steward 1936; Alland 1970); “cultural materialism” (Harris 1979); or “vulgar materialism” (Friedman 1974). Grossman (1977:126) observed that “...geographers have stressed the theme of man’s adaptation of nature, whereas anthropologists have investigated man’s adaptation to nature”.

Geographers, anthropologists and sociologists have all contributed to various aspects of the understanding of health problems in both developed and less developed countries but in general their entry has been relatively recent and follows “...a shift in orientation from disease to health, and by a consequent need to define, assess, and preserve health” (Meade 1977:379). Although medical geographers have a long tradition which can be traced to Hippocrates (Mayer, 1982a), they do not have a common approach (Mayer 1982b). In spite of this, several research themes have emerged: an emphasis on disease ecology and disease causation (closely related to medical epidemiology); an emphasis on mathematical modelling and in particular the prediction of rates of disease spread and diffusion in a population (eg., Cliff et al 1981); and an emphasis on access to and delivery of health care (Mayer
The first approach (eg., May 1950) is perhaps the oldest and contains the largest literature and has equally emphasised health care issues in less developed countries (Learmonth 1978) and developed nations (Pyle 1971). The other two approaches, particularly that emphasising health care delivery, have primarily been phenomena of developed nations, and mainly North America. Some medical geographers (eg., Learmonth 1978; Mayer 1982a) have argued however, that geographical epidemiology and health systems planning are or should be inextricably linked. More recent advances in ethnomedicine and cross-cultural medicine (which medical geographers have largely ignored in the past - Mayer 1982b) have demonstrated that both health systems planning and disease ecology have important cultural dimensions (Mayer 1982a). Kleinman (1980) suggests that health care systems are the important cultural link between illness and treatment. Accordingly, the cultural and social basis of health care systems should elucidate the relationship between illness and treatment, and for medical geographers "...the basis for the cross-cultural study of medical geography within the context of the other culture " now exists (Mayer 1982b:267).

Papua New Guinea has been fertile ground for geographers (eg., Clarke 1971; Grossman 1979) and anthropologists (Rappaport 1968; Morren 1974; Vayda 1976; Hyndman 1979) in their application of the human-environment theme. In reviewing the various human-environment analyses of the Tsembaga Maring (PNG highlands), Lowman (1980:9) identified two general approaches: "...ecosystemic studies... [which] have been concerned with how people-environment relations are maintained..." and "...processual [studies which] have elucidated the nature and sources of change in these [relations]".

A systems approach assumes a number of factors, many of which have attracted criticism in recent years. In formulating a systems model, elements and linkages between elements are hypothesised. Assumptions are made about the nature and extent of the relationship between elements - invariably the relationship is a functional one. Earlier systems approaches were derived from
or influenced by cybernetics, and the identification of feedback mechanisms underpinning the self-regulation or homeostasis of human communities was an important objective (Rappaport 1968; 1984).

The reality of enduring stability of human communities through homeostasis has been challenged by some researchers (e.g., Buchbinder's (1973) criticism of Rappaport's (1968) cybernetic model of Maring society; Brush 1975). Buchbinder questioned whether such a (medically) unhealthy society such as the Tsembaga Maring could be said to be in equilibrium. Warfare, Rappaport's claimed regulatory mechanism, was not sufficiently adjusting the people-environment relationship to the point where the majority of people were well-nourished and healthy.

Related to the homeostasis issue is Vayda & McCay's (1975) criticism of the emphasis on energy flows in systems approaches. They labelled this the "calorific obsession" - the energy flow emphasis is based on the assumption that energy is the quest of all. They questioned this emphasis on energy and whether energy is in fact the limiting factor. Rather than focus on energy flows, Vayda & McCay (1975) suggested that the focus should shift towards examining how homeostatic systems change over time in order to stay in the "existential game", and they recommended the analysis of "strategies and response patterns" within human systems to achieve this.

Analysis of "strategies and response patterns" is inherently difficult in a systems framework which does not address the variability within the system. Berlinski (1976, cited in Lowman 1980:10) considered that "...systems models generally have proven too mechanistic and deterministic to account for the effects of the stochastic, catastrophic, creative and historical events common in human life". Meade (1977:393), a medical geographer, conceded the firm connection between human ecology and medical geography but argued that "the holistic perspective [in a systems approach] has inherent methodological problems in analysing the complex cultural interactions of a population with its environment". 
The alternative to the systems approach in the examination of people-environment relations is to consider the nature of processes occurring within the environment. The process based approach aims to understand the basis of the many people-environment transactions. It does not assume homeostasis nor is it reductionist by denying internal variability. Indeed, understanding the nature of variability within a system seems to be paramount in this approach. Brookfield (1962, 1964) was an early advocate of intensive, micro-scale studies which could yield understanding of people-environment relations - particularly the importance of social organisation and culture in perception of and interaction with environment.

"Strategies and response patterns" as a basis for examining people-environment relations has been adopted by a number of diverse traditions and researchers. Some (such as Bennett 1976) have considered the internal variability of actions within a community in terms of their adaptive value. The "Natural Hazards School" of Gilbert White and his colleagues also considers individual and group responses to and consequences of the range of hazards confronted in the environment. Hazards are diverse in nature and extent and may be of a rhythmic or stochastic nature. The concept of the hazard varies cross-culturally in definition, perception and response. If the more restricted view of the hazard is relaxed to include the more common lower magnitude, higher frequency events in addition to the more obvious high magnitude, low frequency ones, the basis exists for examining most people-environment interactions.

Broadly, my loose attachment to the human ecology paradigm reflects a desire to explore the processes producing variability in human interaction with environment and how this variability is important in explaining child malnutrition. This approach is similar to that advocated by Harrison (1985:335) in assessing the distinctive contribution that biological anthropology might make to nutritional studies. He advocates "...the analysis

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2See Torry (1979) for a lucid critique of the Gilbert White School.
of biological causes and effects of the variability in nutritional health and well-being which exists within populations”. Harrison’s recommended approach is processual in kind and differs from the ecosystemic (i.e., “nutrition is part of a total ecological system in which nutritional status is one step in the flow of energy and nutrients”) approach which is often not comprehensively analysed - particularly the energy expenditure components of the energy system (see also MacArthur 1977). Harrison’s approach aims to examine nutritional status “...as a component in the comparative adaptation of individuals or families to their environment...”. It is a two stage approach: to determine the causes of variability and to determine the effects of variability, particularly reproductive effects. Process-focussed research with an emphasis on exploring variability however, does not preclude consideration of regulated and destabilised elements within the community - indeed, a considerable part of the following discussion is concerned with identifying the processes underlying contemporary disequilibria in Abelam economic and child nurturing systems. Thus, this thesis is process centred but examines the inter-relationships between major elements of the community under study.

As the primary research objective is to understand the processes causing malnutrition in under fives, I emphasise child-environment relations. The proximate environment of an under five mainly comprises its family and the biotic, pathogenic world. The child is indirectly influenced by factors affecting the family, particularly economic factors. In a general sense therefore, I have re-defined people-environment relations for investigation purposes as child-environment and family-environment relations.

1.2 Nutrition research in Papua New Guinea

Many explanations have been offered for the widespread nutritional problems in young Papua New Guinea children. The spatial heterogeneity of people and their environments may explain many findings but equally important is the research methodology employed.
...there is no one cause of malnutrition applicable to all areas of Papua New Guinea. What is of prime importance in one area may be incidental in another.

Although the proximate cause of malnutrition is inadequate intake of energy and/or protein (and perhaps other nutrients), explanations for the underlying causes are numerous and the subject of much research. Inadequate subsistence production has been investigated as a possible cause by many researchers and many explanations and possibilities have been offered: the diversion of land and labour to cash cropping (Grossman 1980); male absenteeism leading to labour stresses on the remaining population (Harrison 1976; Bourke and Allen 1979); shorter fallow periods and hence lower yields caused by population growth (Allen et al 1978); and seasonal food shortages (Lea 1964; Whiteman 1965; Bourke and Allen 1979).

Even if the food supply is adequate, other factors have been implicated in the aetiology of malnutrition. Poor knowledge of the value of particular foods has been cited (Bailey 1965; Wookey 1973; Lambert 1976; Bourke and Allen 1979; Shaw 1979); as has poor and delayed weaning (Oomen and Malcolm 1958; Hipsley and Kirk 1965; Bailey 1965). The phenomenon of "low density" (i.e., high-bulk, low protein and energy) foods used for weaning in many parts of Papua New Guinea has also been recognised as a factor in child malnutrition (Binns 1976a) and the use of "high density" foods in the critical weaning period recommended for reducing the incidence of malnutrition (Benjamin and Biddulph 1980). The role of parasites such as intestinal helminths in impairing the individual's capacity to efficiently utilise nutrients was emphasised by Bell (1978). Many other diseases, particularly malaria, play a significant role in the malnutrition process (see Chapter 6).

Broader investigations have identified factors such as land use, agricultural practices, disease and social factors as important influences on the nutritional status of children under five (Clarke and Coghill 1980). These researchers concluded also that the "...nutritional status of the child (0-5
years) varies with altitude and with language groups" (Clarke and Coghill 1980:89). Allen et al (1980) found, in a Southern Highlands population, that child malnutrition was related to household size and garden size which in turn related to the fact that

...the major responsibility for gardening falls upon the women who are incapable of maintaining adequate food production in the face of low and declining yields. (Allen et al 1980:27)

Other explanations have focused on cash cropping as the primary cause of malnutrition. Lambert (1979) sees productive subsistence land being removed from the system by cash cropping, resulting in less food available for local consumption. This hypothesis is not widely accepted and at least one author (Hide 1980) has disputed Lambert's methodology and conclusions as they related to one Highlands community. A related hypothesis is that cash cropping places stress on labour with consequent negative effects on subsistence agriculture (Grossman 1979).

Seasonal factors have attracted research interest in more recent years (Crittenden 1982; Flowers 1983; Ross 1984) although they have been perceived as important variables in the Wosera area of the East Sepik Province for many years (Lea 1964; Whiteman 1965). Many areas in Papua New Guinea have marked seasonal gardening systems which result in periods of food shortage and abundance and therefore may be important variables in the malnutrition process.

A more integrated approach to nutrition research is sought by many. Shaw (1980) called for an approach which

...would help shift the focus of nutrition research and policy away from the proximate causes of infant and toddler malnutrition toward a greater understanding of the child's micro-environment and its impact on her health and nutrition. (Shaw 1980:10).

This research philosophy is also that of the Papua New Guinea Institute of Medical Research (IMR). Dr M. Alpers (1981), the IMR Director, considered that the many nutrition studies conducted in Papua New Guinea in the past were
...not integrated with each other and it is still not possible to draw conclusions about the major deficiencies in the diet of Papua New Guineans in different parts of the country nor about the levels of nutrition, as measured by standard anthropometry, which constitute "malnutrition", that is, represent some threat to the well-being and life of the individual. (Alpers 1981:3)

The IMR has adopted

...an integrated and broad approach...since the Institute believes that studies narrowly focussed on single aspects of food or nutrition may become seriously distorted. (Alpers 1981:3)

The emphasis on integrated, broader analyses of child malnutrition has resulted in greater understanding of Amele child rearing customs and their role in child malnutrition (Jenkins et al 1984). Other recent PNG research which has focussed on the roles of social and cultural processes in child malnutrition includes the work by Montague (1984); Barlow (1984); and Lepowsky (1985).

1.3 Nutrition research in the Maprik area

Abelam territorial limits are wholly contained within the Maprik District (Figure 3-1, page 41) and the Abelam3 are the dominant culture group in the Mamblep, Wora, Maprik, Tamaui, North Wosera and South Wosera Census Districts (CD). Population density varies within the District but parts of the North Wosera CD and locally in other CDs are very densely populated (see Chapter 3). During the 1950s and 1960s the Administration4 became concerned with the obvious health, nutrition, subsistence, and social problems of the Wosera area. A number of officials and researchers prepared reports on the causes of the Wosera problems and what could be done to solve them. Reports to the Administration were prepared by two anthropologists (Forge 1963; Ozer 1965 - an Administration anthropologist); a

3. Throughout this thesis, the terms "Wosera" and "Abelam" are used to distinguish the peoples from the more densely populated North and South Wosera Census Districts (hereafter the "Wosera") from other very closely related peoples (the "Abelam") in the Maprik District. See Chapter 3 for a more detailed discussion of the Abelam.

4. The former Australian colonial administration.
geographer (Lea 1965b); and the Assistant Director of Medical Research, Public Health Department (Schofield 1963). In addition, nutritional findings on the Abelam and Wosera were published by Bailey (1963) and Whiteman (1965; Wosera only). Prior to this particular interest in the Wosera, malaria and other medical surveys had established the generally poor health and nutritional status of the people in the Maprik District (Peters & Standfast 1957; Peters 1960; Schofield et al 1963).

All the reports to the Administration comment on the undernutrition, land shortages, and chronic despair of the Wosera people. Schofield (1963:4) commented that

The Woseras in fact are all in a state of chronic undernutrition, and the worst off for calories of any group studied scientifically in this Territory...Starvation is on the Woseras' doorstep; severe calorie deficiency is already universal and there is no disease which produces more human misery.

Bailey's (1963) comparative survey of Chimbu, Abelam, and Wosera adults and children revealed that the status of Abelam adults and children was worse than in the Chimbu area - at that time the Chimbus were thought to be the worst nourished in the then Australian Territory of Papua and New Guinea. In turn, the Woseras were significantly worse than the Abelam.

Although Bailey (1963:8) had concluded that "...an apparent chronic total food shortage of some severity in the Wosera" existed, there were few quantitative dietary intake and other data which could further assist in understanding the proximate causes of the problem. Whiteman (1965), a nutritionist, worked in the North Wosera Abelam village of Saragum for parts of 1962 and 1963. Her work arose from Administration reports concerning possible land and food shortages in the area. Whiteman (1965:73) concluded that

...whilst...there does seem to be a reduced intake of calories at certain times of the year, the situation at the present time is not as bad as the impression that one gets from talking with the villagers.

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5Yenigo village, a northern, less densely populated foothills village, which was the site of Lea's (1964) work.
She further considered that energy intakes were largely in equilibrium with energy expenditure, but to achieve this balance, the level of agricultural activity which she observed meant that Saragum villagers should be classified as "sedentary workers" (p.74). In many respects Whiteman's analysis is frustrating in its lack of essential data (see Chapter 5) and the seemingly dismissive conclusions which virtually deny the existence of a nutritional problem. Lea's (1965b) report to the Department of District Administration noted the direct contrast between Whiteman's (1965) conclusions and those of Bailey (1963), Schofield (1963) and himself.

A significant reason for the problems in parts of Wosera territory stems from Administration control over land boundaries and village locations. At the time of *Pax Australiana* in 1937, the Wosera were still expanding their territory (Forge 1963). Before 1937, the Wosera population was believed to have been increasing and land fertility declining. Although the Administration temporarily lost control during the WW2 years and up to 1948, when control was re-established, all territorial expansions and boundary shifts from 1937-1948 were annulled (Forge 1963). Thus, those villages seeking to violently adjust their people-land ratios were prevented from doing so and by 1963, Forge (1963:11) concluded that "...there is no doubt whatsoever, that there is a serious shortage of land in the Wosera".

The intense period of interest and research into land and nutritional problems of the Wosera was not followed up with either further research or significant intervention strategies until 1983 when detailed nutritional research in the North Wosera village of Numamaka was undertaken by Ross (1984). Ross (1984:abstract) concluded that "...population pressure and economic underdevelopment have resulted in serious widespread malnutrition in pregnant and lactating women and in their children".

The nutritional and health status of Abelam was still poorly understood however, until preliminary results emerged from the 1982-83 National Nutritional Survey (NNS) (Dr. P Heywood, pers. comm. 1983). Later, more
precise results of the NNS (which included altitudinal zones in the sample strata), revealed the Maprik District to be one of the worst in its altitudinal zone and indeed in the country (Heywood 1985:7). Absolute malnutrition rates were very high: the 12-23 months age group was the worst with 67.2 percent of the sample (n=174) below 80 percent of the standard weight for age; 38.5 percent were below 90 percent of standard length for age; and 69 percent were below 90 percent of the standard weight for length. Without detailed data, the reasons for this were unknown, although the population in the District had increased by more than 50 percent between 1958-59 and 1980, and some non-Wosera Abelam villages were beginning to physically resemble their Wosera counterparts.

Thus, at the time of choosing a field site, the possibility of general malnutrition in the Maprik District being a virtual repeat of the Wosera problem identified in the 1950s and 1960s was important in my thinking. Was the Wosera problem an expanding one? I considered that an Abelam village intermediate in population density and forest fallow characteristics between the densely populated Wosera and the more sparsely populated northern foothills would be an ideal location to examine the issue of child malnutrition.

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6In September 1986, a multi-disciplinary IMR research team made a “rapid appraisal” of the Wosera “problem” and in particular the nutritional problems of the region. A fresh examination of the Wosera circumstances is certainly warranted given the considerable socio-economic and environmental changes which have occurred since the early research of the 1950s and 1960s.
CHAPTER 2
DATA COLLECTION AND ANALYTICAL METHODS

2.1 Site selection

After considerable travel within and around the Maprik District during August and September 1983, I finally selected the Abelam village of Gwelikum 2 as my research base. The village is intermediate between the Wosera and northern foothills villages in terms of forest fallow age and population density. Coffee and cacao growing is well established and the village has many malnourished children - both typical features of most Abelam villages visited. I remained in Gwelikum 2 from September 1983 until September 1984.

2.2 General methods

In general, my data were collected in the participant-observer mode and although I (and my family) attracted much attention in the early weeks, I soon became a relatively normal part of Gwelikum life. How a researcher operates as a participant-observer obviously varies according to inter-personal skills and varies cross-culturally, and in the case of the Abelam, I was constantly aware of the need to structure questions and interviews to minimise bias. With Abelam informants, it is particularly easy to obtain information which is determined by the nature or frame of the question. Some aspects of my work presented special difficulties because of widespread cognisance of my general research objective. Nutrition and health extension messages, through a variety of media, have been common since the late 1970s in the Maprik District, and arising from this is a kind of normative or model behaviour which is applied when appropriate. The model behaviour differs
from the reality of dietary, child nurturing, and sickness management behaviour and my questions and discussions frequently elicited the model answers. Much of the data and conclusions concerning these behaviours were derived more from numerous passive observations rather than my guided or active role as a researcher. In some instances, insights or patterns emerged only after months of almost countless observations or a chance remark or event which provided a Gestalt to the numerous, seemingly unrelated phenomena.

The types of data which I thought necessary to satisfy my broad research objectives were equally broad and wide ranging. It was clear from the start that a major effort would be needed to meet my objectives, particularly to quantify the array of economic activities, child anthropometry, dietary intake data, and the plethora of social and cultural variables. Time and financial constraints limited the range of data types and depth of investigation - compromises were unavoidable. I collected most data, although for some tasks, I paid local assistants. Wherever possible, a broad range of informants was used. I found the use of few informants too unreliable - the larger the number, and in a wide range of different circumstances, the more reliable the data proved. In addition, my wife assisted me with many aspects of data collection.

Prior to fieldwork, Dr. Peter Heywood advised on anthropometry and provided the necessary equipment. Two medical surveys were conducted on my behalf by staff of the Maprik Hospital.

In general, although the data types vary considerably, they fall into four broad categories: direct observation of people and measurement of the results of their activities; information derived from informant recollection; elicitation of beliefs, values and attitudes on a wide range of matters; and secondary data.

Throughout the fieldwork period I used pidgin, the most common lingua franca of Papua New Guinea. Pidgin was necessary as English is spoken by
few villagers and my understanding of the Abelam language was slight. Towards the end of my stay I could understand simple Abelam conversations but my own proficiency was restricted to a few utterances.

2.3 Child anthropometry

In order to quantify the extent of malnutrition in Gwelikum under fives and the extent to which nutritional status varied seasonally, weights and lengths of all Gwelikum 1 and 2 (see Section 3-1 for an explanation of village numbering) under fives were recorded on a number of occasions. I included Gwelikum 1 to obtain a larger sample. Other than dietary recall data, the incidence of *Tinea imbricata*, and Gross Motor Development (GMD) milestones, no other data were obtained from Gwelikum 1.

Most under fives were weighed and measured on a number of occasions between October 1983 and September 1984, but for various reasons some were not surveyed. In Gwelikum 1, I made eight weight surveys (at six-weekly intervals) and lengths were obtained on alternate occasions. Each survey included an average of 50 under fives. Gwelikum 2 under fives were weighed nine times and their lengths recorded six times. The intervals were the same as for Gwelikum 1 but dates varied. Average coverage was 40 children per survey. In both villages, cover generally exceeded 90 percent of all under fives. Weights and lengths were recorded according to the methods described by Jelliffe (1966). Weights were measured with a *Salter* 235/6 hanging scale weighing up to 25 kilograms in 100 gram units. Each child was placed inside a string bag owned by me (with the scales adjusted to zero). Most Gwelikum children under five are naked in the home setting, so the weight of clothing was not a problem. Lengths were measured on a measuring board constructed by the IMR at Madang. This device measured up to 110 centimetres in 1 millimetre units. Younger children (ie., <2 years of age) were measured in the supine position, and children >2 years of age in the standing position.
All anthropometric data were collected in the child's hamlet. To maximise coverage, each survey started at day break, visiting each of the many dispersed hamlets before families went to their gardens. The original intention was to work in conjunction with the mobile Maternal and Child Health (MCH) clinic which visited the village monthly but after attempting this in October and November 1983 this aim was abandoned. The MCH clinics attract about the same number of mothers and children each month, but of the three villages involved, in one month, women from one village may not have attended, while in the next month there was good attendance from that village but poor attendance from another. This situation was too unreliable for my purposes. In addition, the clinics were chaotic and attempts to obtain length measurements from frightened children only served to instil fear in most of the others. As I wished to also collect dietary recall information on these occasions, the large numbers of observers and the occasional critical remarks made by the nurses to the overheard answers made this a difficult exercise. I therefore decided to separately visit the hamlets, weigh and measure the children in relatively calm circumstances and obtain the dietary recall data in a more relaxed and less stressful environment. Those mothers who had difficulty recalling exact details of the previous day's meals were sometimes assisted by co-hamlet dwellers who may have eaten some of the same meal. Thus, better quality data were obtained in these conditions than would have been possible in the MCH setting. Basic data were collected also on the spatial occurrence of *Tinea imbricata* infected children and adults. In addition, all MCH clinics were attended as an opportunity to record weights and lengths for the occasional child missed during the other surveys.

On all surveys, I was accompanied by a Gwelikum assistant (on some

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1A nationwide service responsible for: ante-natal immunisation, all immunisations for under fives, nutritional monitoring, provision of nutritional, hygiene and health advice to mothers, and primary health care services including dispensing of drugs and first aid.

2Gwelikum 1, Gwelikum 2 and Nerikum.
occasions by a woman, and on others by a young man) and between December 1983 and July 1984, by my wife.

Gwelikum adults were weighed and heights recorded twice (February 1984 and July 1984). A tape measure fixed to a plank was used to measure heights, and bathroom scales (Waygood) to record weights.

**Calculation of growth variance over time**

Overall growth variance was calculated by aggregating each child's record for each relevant month. This method produces a total variance for the growth index being considered. Total variance is a product of firstly, variation over time, and secondly, differences between the individuals comprising the population.

Total variance however, does not permit the separation of inherent variability (ie., the differences between individuals at a point in time) from possible seasonal variability. If the mean growth indices for each age group are analysed for variance it is possible to estimate the proportion of total variance which may be attributable to temporal factors. By adopting the mean values for each of the relevant months, variance due to individual differences in each cohort is excluded.

Mean weight-for-age (W/A), length-for-age (L/A), and weight-for-length (W/L) values for each age group have been converted to standard scores (ie., Z scores) using Gwelikum scores only, in order that the growth index can be assessed, for any month, as being above, below or at mean growth performance for that age group for the time series under consideration.

**2.4 Difficulties with existing dietary intake assessment methods**

It should be emphasised here that measures of dietary status do not measure nutritional status (Young 1980:90-91). Such dietary measures are not direct measurements of nutritional status but are of value in interpreting nutritional findings.

At the start of fieldwork I intended to use three methods in
combination to assess dietary intake. Quantitative aspects were to be assessed by the “weighed intake method”; relative frequency of consumption and qualitative data by the “24 hour recall” approach; and behavioural or “real” data from unobtrusive observation. Although I began collecting the non-quantitative dietary information almost immediately, it was not until May 1984 (8 months later) that I attempted a systematic “weighed intake” survey of a limited number of families. This was deliberate as I wanted to satisfy two objectives: to allow the main subject families to become fully familiar with me and my family and for me to become acquainted with the normal behaviour of the families concerned; I wanted to focus the quantitative surveys on two specific months, one representing the “lean period” and the other, the “season of abundance”.

During the long period before starting the quantitative method of assessing intake, I became increasingly concerned that the method had the potential to seriously determine the outcome. When I eventually used the technique, these fears were confirmed.

The commonly used “weighed food intake” method has the objective of accurately quantifying, for a representative sample of the population, intakes of energy, protein, and other nutrients. It is the most labour intensive and time consuming method of establishing dietary intake values. The nuclear family is the usual unit of analysis. For accuracy in non-literate societies, this method involves the researcher’s presence with the family for most or all of the review period (3 or more days).

For each meal the menu, weighed ingredients, foods not eaten after preparation, family members absent, and visitors present should be recorded. In addition, any special foods for small children, snacks, and food eaten by animals should be recorded (Reh/WHO 1962). Ideally, a quantitative record of all foods eaten is made and the weights, heights, ages and sex of the consumers noted for later calculation of nutrient intakes.

The “24 hour dietary recall” method is another commonly used dietary
intake assessment approach. There are many variations of this method, mainly relating to the extent to which quantification of intake is attempted. It is suited to circumstances where high levels of quantitative accuracy are not required and where time is restricted. It is possible to representatively sample a relatively large population in a short time. The food preparer is usually asked what foods were eaten by the household for each meal on the previous day. Some versions of this technique attempt to quantify dietary intake. In non-literate/numerate societies quantification can be difficult but attempts to overcome this by the use of "reference quantities" have been made (e.g., Crittenden 1983).

In some instances, both approaches are used: the "weighed intake" method provides quantitative data which can be considered in relation to nutrient requirements of the individuals concerned, and the recall method a larger, more representative qualitative summary of nutrient intake patterns. The latter method may also provide some quantitative, but less accurate estimates of intake.

The methodological rubric of most "weighed intake" research usually contains some reference to the way in which any inherent weaknesses in the approach have been averted or pre-empted.

In order to combat the tendency to create a favourable impression, especially on the first day, the invitation to participate (in the survey) was made with very little advance warning, usually the evening before. The purpose of the study was fully explained to the adults of the household and the various threats to validity were described and warned against (Ross 1984:59).

Another example:

...the five days immediately preceding the survey were spent living in the village, ...and several meals at each household were observed and weighed to accustom members to the intrusion ...every effort was made to cause as little disruption as possible to the normal eating habits of the household (Harvey and Heywood 1983:97,98)

The possibly deterministic effects that such surveys may have on the outcome are thus clearly recognised. My own experiences led me to conclude that at Gwelikum the "weighed intake" technique significantly determined the
outcome and that it was not possible to avert the above types of problems. A method of data collection which involves the actions of both observer and participants and in which all persons concerned are supposed to be behaving normally must surely be an impossible task - certainly the deliberate and obvious awareness of the exercise's objectives by everyone concerned must be very rare in any behavioural studies. To an outside observer with little or no familiarity with the particular quirks and behaviour of individual families, any behavioural shift, especially slight changes, may not be perceived. This will be especially so if the modified behaviour still falls within the range of normal practice for that cultural group. At Gwelikum two main kinds of determinism arose from the technique.

1. Qualitative Determinism: in which the nature of both staples and accompaniments and cooking methods used is influenced by the survey. Two examples will illustrate. The first concerns a pre-arranged weighed intake survey and the second, an unannounced call on a family well known to me. In the first example, I had gone through all of the usual "explanations of purpose and threats to validity" preliminaries and was confident that my intrusion would be of minimal consequence. On arriving at the house soon after daybreak, I found a meal of peeled and sliced yams, beans, Abelmoschus manihot, and coconut milk being prepared. This is a typical Gwelikum meal but it is only very rarely cooked in the early morning. This family was unlikely, in normal circumstances, to prepare such a meal - their usual pattern was to roast food in the morning. This is an example of a behavioural shift in the direction of "model" nutrition behaviour. Almost without exception in Gwelikum, if a mother is asked about "proper weaning foods" or "proper nutrition cooking" she will recite the extension messages from the MCH Clinic and Women's Club.

In the formal setting of the weighed intake exercise, the participants were unable to divorce me and my purpose from the nutrition cooking direction that they had been encouraged to follow. My presence was thus
inextricably linked to the desirable view of "good nutrition". Not surprisingly, small but significant behavioural shifts occurred (either consciously or otherwise). The term "nutrition" therefore has significance and is understood in Gwelikum although the tenets of "nutrition cooking" have not been incorporated into the daily dietary lives of most villagers (Chapter 7). When appropriate, dietary behaviour alters to accommodate the official or approved nutrition objectives and messages.

With another family, I decided to attempt a weighed food intake without giving prior notice to the family. Once again, the family was well known to me and I was familiar with their normal meal patterns. When I arrived at their house soon after dawn, I explained my purpose and was granted permission to weigh foods. The meal prepared was roast sago, but without coconut. Roast sago, with or without coconut, is a very popular food in Gwelikum but is also derided by MCH Clinic nurses and educated mothers. Sago in this form is merely concentrated energy, and in this respect it is good, however it contains less than 0.01 percent protein and very few other nutrients. At the MCH Clinic, if a mother is being counselled, or more often criticised, by the nurses for the poor nutritional state of her child, the inevitable issue of "sago only" meals arises. Thus, although the food is popular, it is rapidly becoming a low status food, particularly when considered in relation to yams which are the superior food. Its low status now is associated also with its nutritional value in a Western sense. In these circumstances, given the "new meaning" of roast sago, it is highly unlikely that such a meal would appear in a "weighed intake" survey at Gwelikum where advance warning was given. Indeed, the family head said to me afterwards that if he had known of my visit beforehand, the sago would have been fried with *Saccharum edule* inflorescences and grated coconut! I detected some slight embarrassment at my unexpected visit and its purpose. Similar feelings were noticed at other households where this took place.

2. Distributive Determinism. This is where the outcome is biased by the physical requirements of the technique. The technique demands:
• accurate measurements of ingredients and proportions in various dishes;

• accurate measurements of individual allocations

In the "weighed intake" method the first requirement is quite easily met. It is the second requirement which is much more troublesome in practice, for a number of reasons.

First, the technique implicitly prefers that food be allocated in individual portions or servings. The cook, knowing the researcher's objectives and seeing the food weighing scales, serves individual portions. This will necessarily be the case with soups but with various boiled dishes, a communal meal might otherwise have been arranged. Thus, the technique biases the serving method.

Second, the allocation stage is itself altered from being an automatic, almost unconscious process to one of conscious, reasoned serving. During many casual observations of meals served and discussions with the women concerned, I concluded that the serving process is not usually one requiring conscious effort - it is habitual. The cook, knowing the purpose of the survey, adjusts the allocation to some perceived appropriate quantity. Once again, as with the term "nutrition", most mothers know the MCH Clinic or Women's Club views on separate servings for young children, and in the circumstances of the survey, the "model" behaviour will be observed.

Finally, the technique cannot be applied in the following situations:

(a) When the family decides to disperse during the course of the day. What should the researcher do? Follow the young children into the forest or stay with the mother and her toddler in the garden? I am certain that if the child group is followed their behaviour will alter dramatically - for example, they are unlikely to openly steal fruit in the presence of the observer - or should the head of the household be followed to Maprik, and his beer and fried flour and fish cakes be weighed there? These examples are common and illustrate the nature of the problem. I suspect that the implied
requirements of the technique may have a subtle "anti-dispersion" bias - illustrated by the fact that Ross (1984:59), in his two, three-day weighed food intake surveys of nine households (forty individuals), needed to exclude only two adult males and a six year old boy from his analysis on the basis of their absence in the second survey. The small number absent the second time suggests an observational bias. My frequent observations of families conclude that it is normal for at least one of the family members to be absent for at least one meal each day. The requirements of the technique distort these normal behaviour patterns.

In any event, one of the main objectives of the method - that of obtaining concrete data - is eroded somewhat with the necessity to include some dietary recall estimates in some meals of some of the participants. Both Harvey & Heywood (1983:97) and Ross (1984:60-61) documented the circumstances where recall data were used. The impossibility of being with all people at all times necessitates the use of such supplementary recall data. Thus, some compromises are necessary.

(b) A slight "family isolation effect" operates in survey conditions. During the survey, I noticed that the normally highly fluid and casual food exchanges of a hamlet were moderated. Some of the other families believed that allocations of food would disrupt my work and therefore kept away. Thus, there are major practical problems in this type of situation. Sago soup, for example, may contain from 10 to 18 percent sago and 12 to 20 percent greens (as a proportion of total mass). If an unexpected dish of sago soup is offered and accepted, an estimated rather than actual value for the ingredients must be adopted since the original ingredients were not weighed. Quite apart from difficulties with food movements between families, intra-family movements and transfers are difficult to measure. In addition, young children eat selectively (e.g., if greens are too large or are disliked) and with spillage, measurement difficulties arise. Ravenous dogs consume scraps and raid momentarily unattended bowls - they do not wait for the remains to be weighed!
(c) The technique alters the timing of meals. One family in my hamlet sometimes ate so late that the youngest child (2 years old) was often asleep before the main meal was served. If this family were part of a "weighed intake" survey, such an event would not occur. It is likely that the family head would insist that his wife prepare the meal earlier to avoid wasting my time.

These various difficulties with the "weighed intake" method relate to my experience of its use in the Gwelikum context only. Some of the points, however, have been addressed elsewhere - for example Marr (1971, in Young 1981:108-109) stated that "...the weighed intake record gives a precise measure of intake, but not necessarily of customary consumption". Other criticisms of the method exist but will not be discussed here (see Young 1981).

With the "24 hour dietary recall method", different problems emerge. The major difference is that this method is historical whereas the weighed intake method is contemporaneous with the behaviour under study, and hence in theory, the latter is capable of influencing the outcome. Although an historical method, the recall approach has its problems of interviewer bias. The following factors may explain differences between the actual behaviour and what is reported.

1. Memory difficulties. Inability to recall full details of recent events is a common enough human weakness but my experience in Gwelikum village is that this was not a major problem in recalling dietary events of the previous 24 hours.

2. Status of certain foods. The status of some foods is undergoing reappraisal. Foods which are of low or are losing status are insects, wild greens, wild fruits, pawpaws, wild yams, and certain animal proteins such as local fish and bandicoots. Foods of high status include all of the imported store foods such as rice, tinned fish, and meat, flour, biscuits and beer. There is a slight tendency by informants to under-report the low status foods and over-report the high status ones.
3. Seasonal and gender/age related food prohibitions. In principle, food prohibitions apply to both men and women at various times of the year, notably during the growth phase of ceremonial yams, but the reality is different. For example, animal proteins are prohibited in the ceremonial yam growth phase - however, should a person or a family dog fortuitously capture say, a bandicoot, it will undoubtedly be eaten but surreptitiously. Depending on the circumstances of the dietary recall (ie., whether other persons are present) the consumption of the meat may or may not be reported. When cultural dictates conflict with actual behaviour, there may be a tendency to err on the side of culturally sanctioned behaviour and so under-report. In Gwelikum however, although many people believe in the various food prohibitions, individuals now feel that they can act according to conscience - there is a constant testing of the power of such prohibitions - and accordingly this problem with the technique is relatively insignificant.

Consumption of fruit is widely under-reported. Adults (particularly men) regard many fruits (eg., introduced fruits such as pawpaws, citrus, pineapples) as something less than food. Such foods are "not strong" and adults are loathe to admit eating them. As they are not "real foods" they easily slip from consciousness when recalling foods eaten. On the other hand, from extensive observations of families over one year, the organised family consumption of such fruits is rare. The main exception is *taun* (*Pometia pinnata*) fruit - virtual feasts occur during the short fruiting season. Much fruit is eaten by unsupervised children, and much of it is stolen.

4. Quantitative and qualitative recall inaccuracies. At one evening meal observed, a number of dishes were prepared - in the following order: roast yams; boiled yams and *Abelmoschus manihot* leaves; sago soup with *Gnetum gnemon* leaves, and yam soup with *Gnetum gnemon* leaves. The first dish was prepared at about 5.30 PM and the 22 months old boy ate his allocation of one small tuber. He also ate a small portion of boiled yam about an hour later but ignored the greens. He was very tired by the time the sago dish

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"tulip" = *Gnetum gnemon*  
"aibica" = *Abelmoschus manihot*
was served (8.30 PM) and ate only 2 or 3 spoonfuls. He was asleep before the last dish was served at about 9.30 PM. The next day was a regular "dietary recall day" and this family reported that all meals were eaten by their son. On this occasion, although the general description of the dishes prepared for the meal was accurate, a number of details were incorrect:

* the child did not eat the greens of part 2 of the meal,
* the sago soup was only sampled by the child, and
* the child did not eat any yam soup as he was asleep.

These problems consistently occur with most families, thus the technique is deficient in its ability to elicit the full realities of past behaviour.

2.5 Dietary intake assessment methods

I was unable to satisfactorily sample and quantify normal patterns of dietary intake in Gwelikum under fives. The method eventually adopted was a combination of dietary recall and some quantitative data. As such, the data yielded are estimates or indicators only of dietary intake patterns.

Following the initial trials with the "weighed intake" approach and the conclusion that the method was inappropriate for use in Gwelikum village, I nevertheless persisted with the objective of quantifying some aspects of dietary intake. I decided to randomly sample meal sessions (in time and family) in order to:

(a) accurately determine through weighing, the proportions of various ingredients in a given meal; and

(b) accurately determine, in the case of individual servings, the quantities allocated to individuals (noting sex, age).

By repeating this exercise occasionally for a wide range of families over a long period, I was able to determine both the average composition of each meal type and the average serving (plus range) for children and adults. This exercise did not establish average daily nutrient intakes for a sample population, rather it established the average nutrient compositions for randomly selected meals.
Although I weighed meals throughout the whole time spent in Gwelikum village, the weighings were clustered at two times - the first in May 1984, which was the middle of the "lean period" and the second in August 1984 which represented the early stages of the main yam harvest, and traditional "period of abundance". The aim was to establish "standard meal sizes" (and therefore nutrient values) for different age groups which could then be applied to the information obtained by the recalls administered eight times between November 1983 and September 1984.

**Dietary recall methodology**

The dietary recall data were obtained at six-weekly intervals along with the anthropometric data on under fives. The procedures were as follows:

(a) mothers of all under fives were asked to provide details of all foods eaten by their families, and in particular by the under fives in their care, on the previous day.

(b) names of meals and individual components of meals were recorded, as was the cooking method. Wherever possible the specific names, in the Samukundi Abelam dialect, were used. Although pidgin terms were equally specific for most purposes, confusion with certain types of greens sometimes occurred. For example, the pidgin term *kumu* sometimes means pumpkin tips, while at other times it is used as a generic term for all green leaves. To assist with the Abelam language, a paid village assistant always accompanied me when obtaining these data.

(c) The women were also asked whether any bush meats, insects, greens, fruits or fungi were eaten. In most cases, the information was provided in the first instance without cueing - with only occasional additions to the data.

(d) I also recorded whether children ate multiple meals, missed meals, were breastfed or not and whether the child was sick on the previous day.

Thus, for each dietary recall survey, details of all foods eaten and cooking methods used were recorded for each meal time.
Combining the quantitative and qualitative data

Estimates of dietary intake are derived by applying the "standard values" for various dishes (obtained via the random weighings of foods) to the data obtained from the dietary recall surveys. "Standard values" used to estimate dietary intake of protein and energy by under fives were based on an empirical survey of a number of dishes eaten at two different times of the year (Table 2-1). Numerous observations revealed however, that the type of meal to some extent dictated the mass eaten. The extent of this variation is shown in Table 2-2.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Dishes(N) May 1984</th>
<th>Dishes(N) August 1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 5s</td>
<td>12 374 (128)</td>
<td>11 589 (181)</td>
</tr>
<tr>
<td>Adults</td>
<td>17 938 (432)</td>
<td>23 808 (211)</td>
</tr>
</tbody>
</table>

Overall average (SD) for under fives = 477 (193) grams
Overall average (SD) for adults = 857 (334) grams

* Significant.  p < 0.01
** Not Significant but mean difference in soup dish sizes are significantly larger in May (t = 4.76, p < 0.001)

Although a significant difference exists in mean dish size between the worst part of the "lean period" and the "season of abundance" it was difficult, in practice, to determine when dish sizes began to change. Fixed values for the various dishes rather than varying the values over the months reviewed have therefore been adopted.

In estimating dietary intakes, the same standard values are assumed for all under fives. Amounts eaten in a day vary with age, but field observations show that there is little difference in the actual servings given to children aged between two and five years. A two year old however, is more likely to eat only one or two main meals per day whereas a five year old
**Table 2-2:** Standard Net Weights Adopted For Dishes, Children Under Five

<table>
<thead>
<tr>
<th>Dish</th>
<th>Standard Weight (gms)</th>
<th>Number weighed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most yam dishes</td>
<td>500</td>
<td>17</td>
</tr>
<tr>
<td>Peeled yam dishes</td>
<td>400</td>
<td>3</td>
</tr>
<tr>
<td>Taro dishes</td>
<td>500</td>
<td>6</td>
</tr>
<tr>
<td>Most sago dishes</td>
<td>500</td>
<td>26</td>
</tr>
<tr>
<td>Roast sago</td>
<td>150-200</td>
<td>9</td>
</tr>
<tr>
<td>Most banana dishes</td>
<td>400</td>
<td>10</td>
</tr>
<tr>
<td>Banana soup</td>
<td>500</td>
<td>5</td>
</tr>
<tr>
<td>Sweet potato dishes</td>
<td>400-500</td>
<td>2</td>
</tr>
<tr>
<td>All rice dishes</td>
<td>500</td>
<td>(1)</td>
</tr>
<tr>
<td>Roast maize</td>
<td>200</td>
<td>2</td>
</tr>
<tr>
<td>Breadfruit seeds</td>
<td>200</td>
<td>(1)</td>
</tr>
<tr>
<td>Roast “pitpit”</td>
<td>150</td>
<td>(1)</td>
</tr>
<tr>
<td>Peanuts</td>
<td>100</td>
<td>(1)</td>
</tr>
<tr>
<td>Cassava</td>
<td>400</td>
<td>(1)</td>
</tr>
</tbody>
</table>

**Note:**

(1) Not weighed in field conditions. Weights estimated from replicated meals.
follows the pattern of older children and adults. The two year old may eat more small snacks although this is highly variable and virtually impossible to measure. In calculating protein and energy values for each meal type the following procedures have been adopted:

(a) in meals where more than one staple was consumed, each staple is reduced to a fraction of the standard weight eg., a mixed boiled taro/yam dish is calculated on the basis of 250 grams of each, totalling 500 grams,

(b) in meals involving several greens the same procedure has been adopted,

(c) the proportions of greens, animal proteins, staples and water in each type of dish have been based on repeated measurements of meals prepared by various families. In general, the various proportions concur with the tabulated results of Ross (1984:69) but in this analysis the proportions are calculated from Gwelikum data (Tables 2-3 & 2-4).

Table 2-3: Proportions of ingredients in various Gwelikum meals

(A) General proportions.

1. Boiled yams, peeled, with greens
   78% yams, 22% greens

2. Rice, greens, tinned fish
   90% rice, 6% greens, 4% fish

3. Yam soup, greens, coconut
   48% yams, 3% greens, 9% coconut
   48% water

4. Sago soup, greens
   14% sago, 16% greens, 70% water

5. Sago jelly, greens
   21% sago, 14% greens, 65% water

(d) because no measurements of breastmilk intake were taken, no estimates of energy and protein intake are possible from this source.

The contribution to energy and protein intake by various meals of similar weight varies substantially (Table 2-5).

Roasted foods give a concentrated energy contribution, whereas soups
<table>
<thead>
<tr>
<th>Details</th>
<th>Mass (Gms)</th>
<th>Energy (Kj)</th>
<th>Protein (Gms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yam (R)</td>
<td>500</td>
<td>2960</td>
<td>15.4</td>
</tr>
<tr>
<td>Yam (B)</td>
<td>500</td>
<td>2210</td>
<td>11.5</td>
</tr>
<tr>
<td>Yam (B), greens</td>
<td>400</td>
<td>1438-1507</td>
<td>9.5-12.3</td>
</tr>
<tr>
<td>Yam (S), greens, coconut</td>
<td>500</td>
<td>1142-1437</td>
<td>6.7-8.8</td>
</tr>
<tr>
<td>Toro (R)</td>
<td>500</td>
<td>2900</td>
<td>11.7</td>
</tr>
<tr>
<td>Toro (B)</td>
<td>500</td>
<td>2120</td>
<td>8.5</td>
</tr>
<tr>
<td>Maize (R)</td>
<td>200</td>
<td>844</td>
<td>7.2</td>
</tr>
<tr>
<td>Sago (R)</td>
<td>150</td>
<td>1485</td>
<td>0.2</td>
</tr>
<tr>
<td>Sago (R), coconut</td>
<td>200</td>
<td>2814</td>
<td>3.3</td>
</tr>
<tr>
<td>Sago (S), greens</td>
<td>500</td>
<td>636-705</td>
<td>1.8-4.6</td>
</tr>
<tr>
<td>Sago (J), greens</td>
<td>500</td>
<td>800-880</td>
<td>1.8-4.1</td>
</tr>
<tr>
<td>Sago (J), greens, fish</td>
<td>500</td>
<td>1001-1056</td>
<td>5.6-7.9</td>
</tr>
<tr>
<td>Sago (J), greens, grubs</td>
<td>500</td>
<td>1342</td>
<td>8.1</td>
</tr>
<tr>
<td>Banana, uncooked</td>
<td>400</td>
<td>1348</td>
<td>4.4</td>
</tr>
<tr>
<td>Banana (B)</td>
<td>400</td>
<td>1536</td>
<td>5.3</td>
</tr>
<tr>
<td>Banana (R)</td>
<td>400</td>
<td>1944</td>
<td>6.7</td>
</tr>
<tr>
<td>Banana (S), coconut</td>
<td>500</td>
<td>1328</td>
<td>5.4</td>
</tr>
<tr>
<td>Sweet potato (R)</td>
<td>500</td>
<td>2754</td>
<td>9.0</td>
</tr>
<tr>
<td>Sweet potato (B)</td>
<td>500</td>
<td>2295</td>
<td>7.5</td>
</tr>
<tr>
<td>Sweet potato (B), greens</td>
<td>400</td>
<td>1547-1553</td>
<td>8.7-9.3</td>
</tr>
<tr>
<td>Sweet potato (S), greens, coc.</td>
<td>500</td>
<td>1182</td>
<td>4.7</td>
</tr>
<tr>
<td>Rice, greens</td>
<td>500</td>
<td>2082</td>
<td>11.3</td>
</tr>
<tr>
<td>Rice, greens, meat</td>
<td>500</td>
<td>2241</td>
<td>16.1</td>
</tr>
<tr>
<td>Rice, greens, fish</td>
<td>500</td>
<td>2213-2281</td>
<td>13.5-14.6</td>
</tr>
<tr>
<td>Breadfruit seeds (R)</td>
<td>200</td>
<td>1882</td>
<td>13.8</td>
</tr>
<tr>
<td>Pawpaw, uncooked</td>
<td>500</td>
<td>815</td>
<td>2.5</td>
</tr>
<tr>
<td>Pumpkin (S), coconut</td>
<td>500</td>
<td>590</td>
<td>4.6</td>
</tr>
<tr>
<td>Saccharum edule (R)</td>
<td>150</td>
<td>362</td>
<td>7.8</td>
</tr>
<tr>
<td>Peanuts, uncooked</td>
<td>100</td>
<td>2364</td>
<td>25.7</td>
</tr>
<tr>
<td>Cassava (B)</td>
<td>400</td>
<td>1850</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Note: R=roasted; B=boiled; S=soup; J=jelly.

: Energy and protein contributions of some meals varies because of different greens.
Table 2-5: Rank Order of Energy & Protein Value of Some Commonly Consumed Meals. Based on 500 Grams.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Meal</th>
<th>Energy Kj</th>
<th>Protein Grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Roast sago</td>
<td>4950</td>
<td>Breadfruit seeds 34.5</td>
</tr>
<tr>
<td>2</td>
<td>Roast yam</td>
<td>2960</td>
<td>Roast yam 15.4</td>
</tr>
<tr>
<td>3</td>
<td>Roast banana</td>
<td>2430</td>
<td>Rice, fish, tulip 14.5</td>
</tr>
<tr>
<td>4</td>
<td>Roast sw potato</td>
<td>2295</td>
<td>Yom sp, tulip 8.6</td>
</tr>
<tr>
<td>5</td>
<td>Rice, fish, tulip</td>
<td>2236</td>
<td>Roast banana 8.4</td>
</tr>
<tr>
<td>6</td>
<td>breadfruit seeds</td>
<td>2164</td>
<td>Sago jy, fish, tul 7.9</td>
</tr>
<tr>
<td>7</td>
<td>Yom sp, tulip, coc</td>
<td>1437</td>
<td>Roast sw potato 7.5</td>
</tr>
<tr>
<td>8</td>
<td>Sago jy, fish, tul</td>
<td>1056</td>
<td>Sago sp, tulip 4.6</td>
</tr>
<tr>
<td>9</td>
<td>Sago sp, tulip</td>
<td>785</td>
<td>Roast sago 0.6</td>
</tr>
</tbody>
</table>

dilute. Roast sago is an example of a food with very high energy concentration but its protein level is very poor. Breadfruit seeds are middle ranked in terms of energy concentration but are the highest protein yielders.

Nutrient composition of Abelam foods

In calculating the energy and protein intakes for under fives from "standard servings" applied to dietary recall data, I have adopted the composition values for various foods compiled by Ross (1984:117-123) from a number of sources including laboratory analysis of Wosera foods and a literature review. They represent the most comprehensive analysis of the composition of Abelam foods, and since Gwelikum food types are similar to those described by Ross, the use of these values is appropriate. I have also assumed the protein quality level of Gwelikum foods to be similar to Wosera foods and have adopted the "60 percent" level used by Ross. Depending on the supposed biological quality of the protein sources, "safe levels" of minimum protein may need adjustment. A "60 percent" level refers to the value of a particular protein source relative to egg or milk protein which has a protein value of 100 percent - the "reference protein" (see FAO/WHO (1973).

Recommended protein and energy intake levels

The FAO/WHO (1973) recommended minimum and safe levels of energy and protein intake are used. These levels have not remained constant over the years and with fuller knowledge of human physiology, the levels are adjusted from time to time.
2.6 Three dietary intake models

The purpose of developing a series of simple dietary models, each with a number of assumptions about food type, quantities consumed, and consistency of intake, is to test the hypothesis that under certain specified conditions, it is possible to adequately nourish, in terms of energy and protein, all under fives, at 100 percent of the Harvard standard weight for age. The assumptions in the models are based on a combination of adoption of the essential features of nutrition extension messages received at Gwelikum, and the constraints of Gwelikum subsistence economy.

Sources of nutritional information

The main sources of nutrition extension views are:

(a) MCH Clinic Nurses.
(b) The Maprik Hospital Nutrition Ward Staff and Outpatients Staff.
(c) The Gwelikum Women’s Club. The club is affiliated with the East Sepik Council of Women and forms part of a network of similar clubs throughout the Province.
(d) The annual nutrition displays (as part of United Nations “World Food Day”) and theatre organised by the Sepik Agricultural College, approximately 5 kilometres east of Gwelikum.
(e) The annual “Nutrition Week” organised through the Brikiti Community School.
(f) Occasional programs broadcast by Radio East Sepik and Radio Sandaun (West Sepik).

Types of nutritional information

Given the wide range of information sources and their objectives, it is not surprising that a wide range of nutrition views are promulgated. For example, some of the messages seem more appropriate to urban settings - such as those which refer to soft drinks and processed snack foods - and others to circumstances where food prohibitions concerning children exist.

Notwithstanding the varied and sometimes very nebulous information
received at Gwelikum, some consistent themes are widely known by Gwelikum mothers. The most common are:

(a) infants from about 4 months of age should be introduced to an "educational diet" which ideally should include pawpaw, mashed ripe banana, cooked and mashed pumpkin;

(b) sago-only meals should be avoided;

(c) staples should always be prepared with greens and coconut milk;

(d) young children should be fed animal proteins such as tinned fish or pig meat where possible;

(e) under fives should have their own bowls and spoons and be assisted with eating their meals; and

(f) meals should not be missed.

General assumptions of the three models

I have constructed a hypothetical dietary intake model for under fives based on a number of assumptions which are not unrealistic in terms of implementation. The menu optimises nutritional contribution and is based on information widely known within the village. It remains within the limits of cultural acceptability and allows for traditional preferences on occasions. The assumptions of the model are as follows:

1. all year round availability of beans, coconuts, tulip, yams and taro;

2. cash availability on a consistent basis in order to buy rice and tinned fish;

3. three meals per day, every day;

4. menu composition, over time, using the following cooking methods:

<table>
<thead>
<tr>
<th>Cooking Method</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roasted</td>
<td>19 percent</td>
</tr>
<tr>
<td>Simple boiled</td>
<td>10</td>
</tr>
<tr>
<td>Processed Boiled</td>
<td>29</td>
</tr>
<tr>
<td>Non-sago soups</td>
<td>19</td>
</tr>
<tr>
<td>Sago soups</td>
<td>9</td>
</tr>
<tr>
<td>Rice/fish meals</td>
<td>9</td>
</tr>
<tr>
<td>Processed sago</td>
<td>5</td>
</tr>
</tbody>
</table>
Precise details of the meals comprising the above are in Table 2-6.

Utilising the "standard servings" for under fives (see Table 2-2), for the various dishes in the hypothetical menu, mean daily energy and protein intake values have been calculated (Table 2-7).

The "hypothetical diet" has significantly higher energy and protein values and is less variable (as shown by lower standard deviations). The next phase applies the "hypothetical diet" to a simple model.

**Model 1 - specific assumptions**

1. Children in each age group are at 100 percent of the Harvard weight standard.

2. FAO/WHO (1973) energy and protein requirement values have been used.

3. All children consume the same quantities ie., 100 percent, of the "standard servings".

**Model 2 - specific assumptions**

These are the same as in model 1 except that children at different ages now consume different quantities. It has been assumed that a 30 month old child is the "standard child" ie., consumes 100 percent of the "standard serving". Younger children consume less, older children more. Determining addition and subtraction factors is very difficult and arbitrary, but for this model I have assumed the following intake levels:

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>Percentage of &quot;standard serving&quot; consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>70</td>
</tr>
<tr>
<td>12</td>
<td>80</td>
</tr>
<tr>
<td>15</td>
<td>80</td>
</tr>
<tr>
<td>18</td>
<td>85</td>
</tr>
<tr>
<td>21</td>
<td>85</td>
</tr>
<tr>
<td>24</td>
<td>90</td>
</tr>
<tr>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>36</td>
<td>105</td>
</tr>
<tr>
<td>42</td>
<td>110</td>
</tr>
<tr>
<td>48</td>
<td>115</td>
</tr>
<tr>
<td>54</td>
<td>120</td>
</tr>
<tr>
<td>60</td>
<td>120</td>
</tr>
</tbody>
</table>

**Model 3 - specific assumptions**

All model 2 assumptions are incorporated as are the following variations:
### Table 2-6: Meals used in hypothetical dietary intake models

<table>
<thead>
<tr>
<th>Day</th>
<th>Details</th>
<th>Energy (KJ)</th>
<th>Protein (gms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 M</td>
<td>Yams, tulip, beans, coconut milk</td>
<td>1771</td>
<td>13.9</td>
</tr>
<tr>
<td>N</td>
<td>Sweet potato, aibica, tulip</td>
<td>1553</td>
<td>9.3</td>
</tr>
<tr>
<td>E</td>
<td>Yam soup, tulip, coconut</td>
<td>1437</td>
<td>8.6</td>
</tr>
<tr>
<td>2</td>
<td>M Taro, tulip, coconut milk</td>
<td>2512</td>
<td>15.2</td>
</tr>
<tr>
<td>N</td>
<td>Yams (B)</td>
<td>2210</td>
<td>11.5</td>
</tr>
<tr>
<td>E</td>
<td>Rice, tulip, fish</td>
<td>2236</td>
<td>14.5</td>
</tr>
<tr>
<td>3</td>
<td>M Yams (R), Taro (R)</td>
<td>2930</td>
<td>13.5</td>
</tr>
<tr>
<td>N</td>
<td>Sago, beans, tulip, steamed</td>
<td>1962</td>
<td>7.3</td>
</tr>
<tr>
<td>E</td>
<td>Sago jelly, tulip, fish</td>
<td>1056</td>
<td>7.9</td>
</tr>
<tr>
<td>4 M</td>
<td>Sago (R), coconut</td>
<td>2014</td>
<td>3.3</td>
</tr>
<tr>
<td>N</td>
<td>Yams, tulip, aibica, coc. milk</td>
<td>1886</td>
<td>17.9</td>
</tr>
<tr>
<td>E</td>
<td>Yam soup, tulip, coconut</td>
<td>1437</td>
<td>8.6</td>
</tr>
<tr>
<td>5 M</td>
<td>Sweet potato, tulip, pumpkin tips</td>
<td>1553</td>
<td>9.3</td>
</tr>
<tr>
<td>N</td>
<td>Taro (R)</td>
<td>2900</td>
<td>11.7</td>
</tr>
<tr>
<td>E</td>
<td>Banana soup, coconut</td>
<td>1328</td>
<td>5.4</td>
</tr>
<tr>
<td>6</td>
<td>M Bananas (B)</td>
<td>1536</td>
<td>5.3</td>
</tr>
<tr>
<td>N</td>
<td>Yams, tulip, beans, coconut milk</td>
<td>1771</td>
<td>13.9</td>
</tr>
<tr>
<td>E</td>
<td>Rice, tulip, pumpkin tips, fish</td>
<td>2236</td>
<td>14.5</td>
</tr>
<tr>
<td>7</td>
<td>M Yams (R)</td>
<td>2960</td>
<td>15.4</td>
</tr>
<tr>
<td>N</td>
<td>Sago soup, tulip</td>
<td>705</td>
<td>4.6</td>
</tr>
<tr>
<td>E</td>
<td>Yam soup, tulip, coconut</td>
<td>1437</td>
<td>8.6</td>
</tr>
</tbody>
</table>

**Mean per meal**

- Energy: 1878 KJ
- Protein: 10.5 gms

**SD**

- Energy: 593 KJ
- Protein: 4.0 gms

**Notes:**
- B=boiled; R=roasted
- "tulip" = *Gnetum gnemon*
- "aibica" = *Abelmoschus manihot*
Table 2-7: Energy & Protein Intakes, Hypothetical Menu Pattern, Gwelikum Under Fives (Actual Mean Intakes Shown for Comparison).

<table>
<thead>
<tr>
<th>Category</th>
<th>Energy (Kj)</th>
<th>Protein (Gms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothetical</td>
<td>5633</td>
<td>656</td>
</tr>
<tr>
<td>Actual</td>
<td>4021</td>
<td>1354</td>
</tr>
</tbody>
</table>

1. Children aged between 8 and 24 months, for various reasons (mainly illness), do not eat noon and afternoon/evening meals for 25 percent of the time.

2. For children aged 30 months, this factor is reduced to 10 percent, and for 36 months, 5 percent. Children over this age are assumed to eat all meals each day.

The values in these assumptions are probably conservative, especially for the older children, but with the younger age groups, the 25 percent figure is close to the observed value (Chapters 5 & 6).

2.7 Morbidity and health data

Illness data were collected with two principal objectives in mind: to determine the incidence of illness and how it is managed in the under fives; and to evaluate illness history in relation to nutritional status. A number of data sources were used: medical surveys; MCH clinic book records; and observations.

Medical surveys

All Gwelikum 2 under fives (n=43) were clinically examined by Dr Tim Brown of the Maprik Hospital on 24 February 1984. In addition to the clinical examination, blood slides, calibrated blood samples and faeces samples
were collected to test for malaria parasite presence, haemoglobin levels and intestinal parasite presence respectively. Malaria and intestinal parasite analyses were performed by technical staff at the Maprik Hospital and haemoglobin levels by myself using the ammonia solution method and a colorimeter at the hospital.

A second, more extensive clinical survey of the Gwelikum 2 population was conducted on 5 July 1984 by Maprik Hospital personnel as part of a proposed village-based primary health care project. A village-selected, trained, unpaid woman was to treat minor illnesses and provide family planning advice. Twenty Abelam and Arapesh villages were selected for the project. In each case, a base line pre-trial medical survey was conducted.

**Clinic books.**

All mothers of under fives are encouraged to purchase an MCH clinic book and to carry it with them at all times. The clinic book is supposed to record all visits to MCH clinics, the Aid Post, and the Maprik Hospital. It is thus a multi-purpose record (indeed, the only record) and shows details and dates of weighings, illness diagnoses, and treatments prescribed. Clinic book records suffer from accuracy of diagnosis problems (Dr. T. Brown, pers. comm. Jan. 1984) and are not a true reflection of the incidence of illness events. The entries record days of treatment, not all days of illness. This problem is illustrated in Chapter 6 by reference to a limited number of case studies involving my field diary entries compared with clinic book entries for the children concerned.

**Classification of symptoms**

Provisional diagnoses recorded in the clinic books are frequently inaccurate as many disorders have similar and/or multiple symptoms. For example, malaria frequently presents as diarrhoea or with respiratory symptoms, at least in the initial stages of the illness. On other occasions, these symptoms may be absent and fever only is observed. Thus, in analysing clinic book entries, a detailed disease classification has not been attempted, and three symptoms categories only are used:
• fever, and fever in conjunction with respiratory illness and diarrhoea;

• symptoms of respiratory disorders only; and

• symptoms of diarrhoea only.

The records of dead children are excluded as most mothers either destroy the book or bury it with the dead child. In addition, a small number of clinic books for living under fives were so damaged that they were useless and so are excluded also.

In classifying and summarising the MCH clinic book entries, the following entry types are excluded:

• routine trips to the Aid Post for malaria prophylaxis

• treatments for *Tinea imbricata* and scabies. These are usually treated as an adjunct to say malaria treatment. Mothers rarely take their children to the Aid Post specifically for these illnesses, except in the case of badly infected scabies.

### 2.8 Gross motor development (GMD) in Gwelikum under fives

Basic GMD data were noted during my periodic anthropometric surveys of Gwelikum 1 and 2. The data are important as weaning behaviour is influenced more by developmental stages reached rather than chronological age. As an extra question following every dietary recall interview, mothers were asked whether their infants or toddlers could sit, crawl, stand, or walk. Over time, I was able to determine ages of attainment of these basic motor milestones. Guessed sitting, crawling and walking ages are not included.

### 2.9 The subsistence and market economies

From the outset I planned to determine the extent to which economic activity varied in Gwelikum, and the nutritional implications of this variation. Considerable time was devoted to quantifying subsistence and cash cropping activities at the family level. Specifically, I sampled and measured yam stocks prior to planting; determined the "mobility" of seed yam tubers within the village; surveyed food and cash crop gardens; and conducted assets and income/expenditure surveys.
Estimation of yam (*D. esculenta*) stocks

Visits to many yam storage houses soon after my arrival suggested that some families had much poorer food and seed yam reserves than others. I arrived in Gwelikum soon after a drought-affected harvest had been completed. It was clear that some families would experience difficulties in the following year unless seed yams could be procured from elsewhere. I attempted to document the movement of such yams also (see next subsection).

In late 1983, the total *D. esculenta* stocks held by seven families were surveyed. The survey method, developed in the field, was a "rapid estimation" technique with reasonable accuracy (Figure 2-1).

**Figure 2-1: Estimation of yam (*D. esculenta*) stocks**

1. Tubers are stored as follows:

2. Measurements taken:
   (a) two diameter measures, then averaged;
   (b) height of yam pile.

3. Volume calculated using:
   \[ \pi r^2 \times H \]

4. Several test weighings of measured yam piles resulted in a mean mass of 2.91 grams/cm³. This value was applied to volume of yam piles.

Seed yam mobility

During the main food garden planting season, it was clear that some families were relying on other families for their supplies of seed yams. It was
possible that these dependent families were experiencing food supply problems, were marginal, and perhaps had more malnourished children. To examine this possibility, I waited until the end of the 1983-84 planting season, and then asked every man in the village whether he gave away or received seed tubers of either *D. alata* or *D. esculenta* yam species. Data on yams received were under-reported by recipients and donations possibly over-reported by donors. When all replies were cross-matched it was possible to estimate which men received seed yams and the sources of those yams. Quantification was less accurate but all receipts and donations were expressed in *pangal* equivalents. *Pangal* is the Pidgin term for a woody, V shaped spathe of a *Metroxylon sp.* sago palm leaf and is used to carry seed yams. It is of regular shape and carrying capacity and is the standard unit used to plan how many garden blocks can be planted. *Pangals* of yams were converted to block equivalents.

2.9.1 Measuring participation in subsistence activities

**Subsistence gardens**

Ideally, garden yields provide the best measure of adequacy of food supply and hence the most direct independent variable to consider against child nutritional status. Accurate measurement however, of subsistence output for all families with under fives was well beyond my resources. A surrogate measure was chosen - area of current year food gardens. This is not a wholly satisfactory measure mainly because a child’s current nutritional status is a reflection of recent dietary history and accordingly, the area of prior year gardens would be a better measure. However, the current year garden area is determined largely by planting stocks which in turn depend on the size of the previous year’s garden. Although I intended measuring old gardens, secondary regrowth provided physical obstacles, and time did not permit. I have assumed that productivity differences between families are not significant, as numerous visits to all food gardens did not reveal substantial differences in the farming system operated in the main food gardens.

All types of new garden prepared during my fieldwork period were
surveyed for area. This involved measuring all gardens planted in the 1983-84 season. Perimeter length and direction changes were recorded with a tape measure and compass. Individual blocks within the larger garden were recorded also. Areas were calculated using Hewlett-Packard Surveying software. Ceremonial yam gardens were not measured as they are not significant in terms of food production. As it happened, the 1983-84 ceremonial yam crop failed. In these circumstances there is a prohibition against eating any minor crops from such a garden.

Subsistence "capital" and other assets

Other non-cash economy activities were quantified through a survey of assets conducted in October 1983. It was a wide ranging survey of assets and included ownership of coconut palms, dogs, pigs, chickens, cooking and culinary items.

Garden yields

During the 1984 *D. esculenta* harvest I test weighed yields from a number of gardens to determine the extent of the impacts of the 1983 and 1984 droughts on yam yields. The total number of tubers, their mass, and cultivar name were recorded for each planting station. In each case, all stations were weighed in the garden blocks selected.

2.9.2 Measuring participation in the cash economy

Variable participation in the cash economy, like subsistence activities, is an important variable in attempting to explain malnutrition. In addition, expenditure patterns provide information on the non-nutritional end-uses of income.

Cash crops

The area devoted to mature coffee trees was used as a surrogate for income. Mature cacao holdings in 1984 were not extensive and were an insignificant income source. Attempting to quantify income at the family level is a major task and was not attempted. All cash crop holdings were surveyed in July and August 1984, and the areas calculated in the same manner as for food gardens.
Cash circulation

Income as derived does not necessarily equate with disposable income. Money circulates widely in response to numerous obligations and as part of an extensive credit system. The extent of credit was measured by an income and expenditure survey conducted for the week ended 1 August 1984. Apart from regular income receipts and outgoings, all families in the survey (n=39) were asked whether incoming monies derived from either loans taken or loans repaid, and for outgoings, whether loans given or repaid had occurred. A cross-matching of replies documented the credit network active at the time of the survey.

General expenditure patterns

Apart from the single household expenditure survey, obtaining detailed expenditure data at the household level was not possible. Based on written records of the two village trade stores and the licenced tavern, an overall village-level expenditure pattern was reconstructed.

Estimating village and per-capita incomes

Three methods were used: extrapolations from the one-week income survey; the total area devoted to mature coffee and cacao, known planting densities, estimated yields/tree and known prices; and trade store and tavern sales records. All methods produced similar estimates. Income from the sale of vegetables and artifacts is negligible in Gwelikum.
CHAPTER 3
THE ABELAM AND GWELIKUM VILLAGE

3.1 Introduction

The Abelam are the largest linguistic group in the East Sepik Province, and numbered approximately 44,000 people in 1980. They occupy most of the lands within the Maprik District, one of the most densely populated lowland areas of Papua New Guinea (King 1982). In 1980, overall Abelam population density was 59 persons/km² although in some areas, notably in the North Wosera Census District, densities are over 150 persons/km², and in some villages over 230 persons/km².

The Abelam and other geographically close groups form part of a recognisable cultural continuum along the southern slopes of the Prince Alexander and Torricelli mountains of the West and East Sepik Provinces. These groups, some of which are not linguistically related, are well known for their elaborate cultivation of ceremonial yams (D. alata) and associated ritual including yam exchanges, their impressive spirit houses, and art. The Abelam are flanked to the north and west by the linguistically unrelated Arapesh and to the east by the linguistically related Boiken speakers.

The Abelam language belongs to the Ndu family which falls within the Middle Sepik super-stock of the Sepik-Ramu language phylum (Laycock 1973). Related to the Abelam language are the Boiken and Iatmul languages. The linguistic gradation between the Sepik river peoples and the northern most Abelam suggests a south-north migration (Laycock 1965). The presence of large areas of Imperata cylindrica (kunai) grasslands in the southern Abelam areas has been proposed as being anthropogenic in nature (Robbins 1963). It is thought that with increasing population density, land
Plate 3-1: Images - past and present,
above, bapataakwa,
below, Carols by Candlelight
use and burning practices intensified and eventually, secondary forest gave way to permanent grasslands which are of lower fertility and more difficult to cultivate. Thus, it has been hypothesised that a northwards migration followed this environmental degradation. The northernmost Abelam adjoin the Arapesh language speaking groups occupying the higher slopes of the Torricelli and Prince Alexander ranges. Many of these northernmost villages have only recently (i.e., within the last 80 years) occupied, through warfare, land previously occupied by the Arapesh. There are some Abelam outliers in Arapesh territory (e.g., Kuelikum) who have moved northwards in the recent past.

The Abelam themselves are not linguistically and culturally homogeneous. There are numerous minor differences in language, ritual, art, horticultural practices, and sexual division of labour. The internal differences in language have been noted and classifications attempted by some researchers (Kaberry 1941a; Scaglion 1976; Lösche 1983), but although differences exist, they are not sharp and exist more as a cline. Scaglion proposed that the Abelam be divided into two broad groups: "upland" and "lowland", and further, that the "upland" be subdivided into the Western Abelam (the Samukundi and Mamukundi dialect speakers) and Eastern Abelam (the Yambeikundi dialect speakers). He further proposed that the "lowland" Abelam be subdivided into the Wosera Abelam (the Kamukundi dialect speakers) and the West Wosera dialect Abelam, the most linguistically remote Abelam.

scrutiny as the other dialect groups. Scaglion's (1976) analysis of conflict management practices was the first detailed investigation of a Samukundi dialect group. Since then, Lösche (1983) and Huber-Greub (in press) have completed anthropological studies in Samukundi communities.

The Abelam live in villages, although to some extent contemporary villages were in fact village segments\(^1\) nominated as distinct villages by the Colonial Administration for census and revenue collection purposes. In 1980, the average village in Wora CD contained 295 persons. Formerly, village boundaries and locations were fluid, and warfare the mechanism for territorial expansion. With *Pax Australiana* in 1937 village lands were fixed and territorial expansion through warfare prohibited.

The township of Maprik (derived from the name of the adjacent village) which was established in 1937, is the main urban centre in the District although smaller centres are found at Bainyik (Sepik Agricultural College) and Hayfield (Sepik Producers Cooperative Ltd and the Assemblies of God mission base). Village settlement patterns are more dispersed than formerly but still generally reflect traditional patterns. Some hamlets however, are now located to take advantage of roads which pass through village lands.

### 3.2 Social organisation

Within each village, there are a number of levels of social organisation. The Abelam are patrilineal and patrilocal, and members of a patrilineage generally live close to each other, usually within the same hamlet. Settlement is dispersed in hamlets of a few families only. The patrilineage is effectively the sub-clan and is the most important social unit with regard to allegiances and access to land. The various sub-clans (which are unnamed) belong to larger kin groups or clans (*kum*). Each clan has a number of totems (*djambu*) but the most important identifying totem is a local bird species.

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\(^1\)Hereafter, "village" also means "village segment". Contemporary villages derived from village segments are often listed for official purposes under the same name but distinguished by a number - for example, Gwelikum 1, Gwelikum 2, Aupik 1, Aupik 2, Aupik 3 etc.
In addition to clans and sub-clans, there is a moiety system. Lea (1964) and Scaglion (1976) referred to the existence of a dual moiety system. The first of these is a geographical bisection of the village (kumundji/kwiendji - both bird terms); and the second, a ceremonial bisection of the village (termed ara). Although this dual system is widespread, the western most Samukundi Abelam (including Gwelikum and Aupik villages) do not operate the kumundji/kwiendji moiety system - only the ara. Forge (in press) considered the kumundji/kwiendji system to be a relatively new (ie., this century) phenomenon which was spreading from the east at the time of European contact.

Each ara has ideally the same population, and regular adjustments are made to male membership so as to balance each ara. This is vital for intra-village competitive exchange (gei-tschambera) and frequently, the reasons for many child adoptions can ultimately be traced to the need to balance ara. Ara membership cuts across clans, sub-clans and families. Each man has an exchange partner from the opposite ara. The system is thus an institutionalised moderating influence and serves to minimise the potential for aggression, conflict and rivalry between clans and sub-clans (see Tuzin 1976). Ara are responsible also for the initiation of the sons of members of the opposite ara.

In addition to intra-village exchange, the village as a whole competes with another friendly village through very large exchanges of long yams (D. alata or waapi) and pigs (termed waapi-tschambera). A further type of exchange, which is more in the nature of ritualised aggression, occurs with enemy villages (termed the vi-tschambera or "spear exchange").

Within each clan, there are "leaders" known as kumbundu (literally "the man who groups the clan") and within the clans and sub-clans nemandu (older men who command respect) and djuindu (very rich, powerful men) are recognised. All djuindu are nemandu but not necessarily vice-versa. Some Abelam anthropological literature (eg., Kaberry 1941a, 1941b, 1966; Scaglion
1976; Huber-Greub, in press) refers to nemandu as meaning "big man". Literally, this is true but the term also means "elder brother". Most nemandu achieve this named status merely through the passage of years and general industriousness. The Samukundi Abelam term djuindu more appropriately matches the meaning attributed to "big men" by anthropologists. Ordinary, quiet men are referred to as malatukundu and low achievers, lazy and poor men, guaembandu ("rubbish men").

There are numerous men and women with special skills and knowledge but the social and economic organisation is neither large enough or sufficiently elaborate to permit full-time engagement in these activities. Examples include: sorcerers, witches, healers, dream interpreters, clairvoyants, those with special knowledge of garden magic, garden sorcery and advanced initiation rites, pig butchers, makers of traps and snares, artists, cane weavers, woodcarvers, specialist builders, string-bag weavers, oral historians, and various others. Most specialists are men but women are usually associated with witchcraft (kutaakwa) and the manufacture of string bags (wut).

3.3 Settlement patterns

Settlement is dispersed with numerous small hamlets usually occupying ridges which formerly afforded some defence value in times of chronic warfare. Ridges are thought to be healthier places because of cooling breezes and the mosquitoes are not as troublesome. Abelam houses are constructed of timber and thatched with sago palm fronds. They are built directly on the ground and are very dark inside. Formerly, dead family members were buried in shallow graves inside their houses and contemporary houses are often sited so as to incorporate the burial site of kin or ancestors. Most houses face a regularly swept and weeded central plaza and in certain hamlets, these are of ceremonial significance (amei). An amei is generally also the site of a spirit house but if this is absent, the presence of special, centrally located stones ("moon stones") indicate of the special status of the hamlet.
Hamlets are not occupied indefinitely. An abnormal number of deaths forces the remaining hamlet residents to leave and form a new hamlet elsewhere. Deserted hamlets are common and can be readily identified by old coconut palms. Occasionally, old hamlets are re-occupied but before doing so, a ceremony to appease the ancestor spirits must be held. Apart from the planting of coconut palms, various other plants with magical powers are planted in strategic places in and around the hamlet. Examples include *kwaale*, a flax-like plant which reputedly has a powerful anti-aggression effect and wild gingers (*Zingiber sp.*) which ward off malevolent spirits. Edible leaf-producing *Gnetum gnemon* trees, certain plants used for producing twine from the bark, plants used for dye, various fruit trees, banana plants and decorative plants are also found on the periphery of each hamlet.

Hamlets contain various structures. Apart from the traditional house styles (for people and storage of yams), western-style dwellings are built by mainly younger families. Although they are status symbols, they are more demanding of labour, timber, and money. Pigs are not a major feature of Abelam economy but the occasional pig may be housed in a small shelter at the edge of the main plaza. Latrines are located in every hamlet (by law) but are not frequently used. Some hamlets may contain a small trade store which is usually owned by a hamlet resident.

No reticulated water or electricity is provided to villages and hamlets. Water for drinking and cooking is obtained from soaks on the lower slopes away from the hamlets and all washing (cookware, clothes, bodies) must be done in the small streams, some of which stagnate during the dry season. Most villages are not well served by vehicular roads, some not at all, and most movement is by foot along the numerous bush trails inter-connecting hamlets and villages.

Although the hamlet is the main tangible manifestation of human life, it is really only a home base. Most hamlets are deserted during the day, when the residents are usually in their subsistence gardens or coffee/cacao
gardens. Only very old and infirm people remain in the hamlet during the day.

3.4 Abelam economy

The Abelam are swidden horticulturists, annually preparing new gardens from secondary forest (long fallow). The southern foothills of the Prince Alexander mountains are strongly dissected, with many low ridges and small valleys. The forest comprises many stages of secondary regrowth, new and abandoned subsistence gardens, and areas devoted to coffee and cacao gardens.

There is a strong seasonal cycle to Abelam horticulture which is related to a distinct wet/dry season cycle. The usual pattern is a distinct wet season between October and March, with the other months drier. Droughts are known in the area (Kaberry 1941a; Whiteman 1967) and cause food supply problems. The cycle of forest cutting, burning, planting and harvesting is inextricably linked to the regional climatic regime. The seasonal element to gardening and hence food supply is recognised in Abelam culture and each area has a period when food is regarded as in short supply ("lean period"). These traditional "lean periods" vary spatially and according to seasonal conditions.

Hunting and gathering are unimportant in providing dietary energy or protein - the overwhelming proportion derives from subsistence food gardens, planted sago palms (*Metroxylon sp.*) and breadfruit trees (*Artocarpus altitlis*). The most important garden crops are: yams (*Dioscorea alata & D. esculenta*); taro (*Colocasia esculenta & Xanthosoma sagittifolium*); bananas (*Musa sp. cultivars*); sweet potato (*Ipomoea batatas*); maize (*Zea mays*); beans (*Psophocarpus tetragonolobus, Phaseolus lunatus, Vigna sesquipedalis*); and the leafy greens (*Amaranthus sp., Abelmoschus manihot*). *Gnetum gnemon* and pumpkin tips and leaves (*Curcurbita moschata*) are the most common non-garden leafy greens. Maturity times of the various garden
crops varies from about 6 weeks to one year. Store-bought foods (mainly rice, tinned fish and beef) now complement the mainly vegetarian subsistence diet but these have a strong seasonal dimension as coffee is a seasonal crop.

Cash cropping started in the Maprik District in the early 1950s. Various crops have been tried (in chronological order): rice, peanuts, rice again, coffee and cacao (see Shand & Straatmans 1974; Stent 1984). Coffee was the main income producer in the 1970s and early 1980s but major plantings of cacao in the early 1980s will alter the income mix. The seasonal coffee crop yielded an annual per-capita income in Gwelikum village in 1984 of 64 Kina\(^2\). The non-seasonal cacao will eventually spread income (and spending patterns) more evenly over the year. Other than perennial tree cash crops, various economic ventures arise periodically in the area and include the operating of Passenger Motor Vehicles (PMV); village trade stores; pig and chicken husbandry; and cooperative village-based cattle projects. Most of these ventures have failed.

The periodic enthusiasm with business ventures is paralleled by a similar ephemeral enthusiasm with the cargo cult. Village informants told me that a cargo cult emerged in Kalabu village in about 1941 or 1942\(^3\). Although centred on Kalabu, most of the devotees were thought to be from the North Wosera area. Since then there have been a number of cargo movements, the most widespread being the Peli Association in the late 1960s and early 1970s. During 1983 and 1984 there was considerable evidence (although it was meant to be a clandestine activity) of a new cult operating through village catechists of the New Apostolic mission. Lösche (1983) also noted this in the village of Apangai in the early 1980s.

Labour division and specialisation depends on the type of activity. Subsistence gardening shows the most sex-specific labour allocation. In

\(^2\)In 1984, the PNG Kina was worth approximately $1.38 Aust.

\(^3\)This may have been similar to the "proto" cargo cult type events at Aitape at about the same time (B. Allen, Pers. Comm. Nov. 1986).
general, women do more of the continuous, more repetitive tasks and men the most strenuous tasks. This is a generalisation however, and there is considerable overlap in practice (Chapter 8). Men however, spend inordinate amounts of time in their ceremonial yam gardens - high labour inputs for little energy or protein return. There is less labour specialisation in cash cropping - men, women and adolescents undertake all tasks. If a woman has picked, processed, and prepared for sale the bulk of an identifiable quantity of coffee or cacao, she may have exclusive control over the sale proceeds. In normal circumstances, women are custodians of the family income but may not necessarily have control over the funds (Chapter 8).

### 3.5 Belief systems

My discussion of Abelam culture and aspects of their belief systems will be brief. Comprehensive ethnographic and interpretive material is found in the work of Kaberry (1941a, 1941b, 1966); Forge (1962, 1963, 1970, In press); Scaglion (1976); and Losche (1983).

The predominant spiritual entities are the ancestor spirits and various other supernatural beings inhabiting the forest and streams. Although each clan is totemic there is no belief in ultimate descent from the avian emblem species of each clan. Abelam creation stories vary from place to place and some have obviously incorporated post-contact and Christian elements. However, the original creator of humans was a male (*waalesaki*) and the creator of the physical world a woman (*tsiketaakwa* - the Cassowary woman). In the world as originally created, women possessed all real and important knowledge, particularly artistic, spiritual, magical, and most aspects of material culture. Women controlled fertility - they were "closer to Nature".

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4 "Nature" is my term. The Abelam concept of "Nature" is broader than the general meaning used by Westerners in that the supernatural entities are included. As far as I could ascertain, no precise equivalent term exists but the word for "ground" or "earth" (*kepma*) can be broadly interpreted as the material entity through and upon which all natural and supernatural processes occur.
Eventually, men usurped these female affiliations with nature, and became "agents of fertility" through the yam cults, and through control of this type of fertility, men believe that the key to their success is found. This role is an unnatural one for men however, and is not a steady-state condition acquired through birthright. A man's role in controlling fertility is constantly under threat, particularly from women and the gamut of phenomena with female traits. A man is most effective in this role if he can remain "hot". Women are "cold", and men can easily become "cold" if polluted by women (particularly through sexual contact) or "cold" things. Both men and women are especially vulnerable at transitional periods during their lifetimes (especially at puberty and initiation) and both sexes avoid "cold" foods at these times (Losche 1983).

Long-term fertility and success depends on a man's ability to retain vigour and remain "hot". He must adhere to the fundamental Abelam cultural mores - the "laws of the yam". To be a successful ceremonial yam (waapi) grower means the adoption of numerous dietary and sexual prohibitions; the need to minimise disharmony; and the need to appease all relevant ancestor and various other supernatural entities. It is certainly a difficult regimen to follow and attempts to thwart or mislead the "laws of the yam" will not succeed. Failure to follow these laws will result in poor yams and with that, the general failure of the main food gardens, whose success depends also on strict adherence to some of these laws. Blatant failure to conform means that a man is also a failure and will not be able to function adequately within the society in a number of important ways: he and his family will be unable to adequately feed themselves; exchange obligations will be unmet; and his capacity to resolve conflict, should it arise, through yam and pig exchange, will be severely limited.

A number of mechanisms and agencies can facilitate food production. The world is inhabited by various supernatural entities and forces which can both help and hinder humans. No distinction is made between natural and
supernatural entities in the environment: all entities occupy the same time and space dimension. Men must always operate within the various "natural laws" which manifest themselves through these forces. Ancestors also play a significant role in the affairs of the carnate living. It is possible for men to use the various supernatural features of their environment to facilitate their passage through this life with as little stress, disharmony, and unhappiness as possible. In effect, these entities are really "spiritual factors of production".

It is not enough for a man to merely invoke the "spiritual factors of production" and follow the dietary and sexual prohibitions. Avoidance of conflict is absolutely necessary also. To minimise or avoid conflict means that individuals and the community as a whole must provide the necessary harmony and optimal conditions for agricultural success. Not only do the various ancestor spirits, garden and other spirits work to assist the male adherents to the various laws, but conflict avoidance also means that other men or women will not invoke special knowledge or supernatural powers to cause crop failure, illness or death in the person causing the conflict. Thus, sorcery and other malevolent actions are minimised.

Success is ultimately assessed in terms of subsistence performance. In Abelam society, the primary indicator is the ceremonial yam and large surplus production of the lesser yam (Dioscorea esculenta or ka). Similarly, failure is measured in these terms, but other indicators of failure exist also. Sickness and infertility are manifestations of either disharmony between the sufferer and the gamut of sentient natural and supernatural entities in the Abelam world, or between the sufferer and fellow humans - or both.

The Abelam spoken world is dominated by food, not just in a culinary or nutritional sense, but more in terms of its production, its capacity to resolve conflict, and its capacity to create status and power in the user. Virtually all aspects of Abelam subsistence economy are linked to these ideals. Elaborate rules and practices must be followed in order to produce satisfactory ceremonial yams and achieve surplus production of D. esculenta
and other foods. Individual success is quantified at the time of intra-village competitive exchange and village success at the time of inter-village exchange. Inter-personal conflict can be resolved or non-violently attenuated through the exchange of ceremonial yams, pigs and shell rings (yua). Indeed, the need to minimise or avoid conflict is institutionalised within the yam cultivation laws. Should conflict arise, some of the most powerful methods of resolving the problem centre on the transfer of food.

In addition to the spiritual, economic, and political importance of food, there is a cultural dimension to its role as sustenance. A food taxonomy both aggregates and divides various foods. The major groups recognised are tuberous staples, bananas, sago, fungi, breadfruit, animal foods (including insects and fish), and greens. Within each group are many types and varieties of food. Not only does this relatively conventional taxonomy exist but all foods may be further classified according to whether they are male or female; hot or cold; and strong or soft. There is also a complicated system of gender complementarity within and between food sub-groups and groups of food. For example, all yams (both *D. alata* & *D. esculenta*) and varieties are either male or female, and many varieties of *D. alata* have complementary varieties within both *D. alata* and *D. esculenta*. All taros (*Colocasia esculenta*) are female and are matched to various male cultivars of yams. Thus, a male *D. alata* has a female taro partner and possibly a female *D. esculenta* partner. That female *D. esculenta* may also have a male *D. esculenta* in addition to its *D. alata* partner. Not all cultivars have partners however. The hot/cold dimension is more complex - to the Abelam this is more abstract but in most examples hot foods are male foods and cold ones female. Similarly, strong foods (which are usually firm in texture) are frequently male foods. The strong/soft dimension is significant in the progressive introduction of solid foods to young children (Chapters 4 & 7).
3.6 A brief Abelam history

Although an inland people, the Abelam probably had contact with Javanese Bird-of-Paradise hunters who certainly made forays across the mountains further to the west of Maprik (Allen 1985). In the 1890s a smallpox epidemic killed many people from the islands off Aitape (Firth 1982) and oral traditions in Gwelikum describe a sickness like smallpox which spread like a "swarm of butterflies" at about that time. The disease produced numerous lesions on the body and face and was named *waalndu* (skin warty like a breadfruit).

German explorers passed through the Maprik area in 1913 (Thurnwald 1914, 1917a, 1917b; Behrman 1917, 1922, 1924) and some gold seeking and labour recruiting took place in the 1930s. Maprik was founded in 1937 and *Pax Australiana* commenced. The only detailed pre-war ethnographic accounts of the Abelam were made by Kaberry (1941a, 1941b) who lived in Kalabu village in 1939. The area was occupied by the Japanese during the Second World War but was eventually retaken by the Allies in 1945. A dysentery epidemic probably introduced by the Japanese (Allen 1983) killed many people and apart from the demographic effects, lives were disrupted through enforced scattering and abandonment of hamlets. There was also close contact with foreign, opposing cultures, and with this, exposure to different values and belief systems. The traumatising effects of WW2 on villagers of the region cannot be over-estimated (Allen 1984). Control was re-established by the Administration in 1948, and with it, freezing of village boundaries and territories (Forge 1963).

Little social science or medical research was conducted until the late 1950s and early 1960s. Various medical researchers established the nature and extent of malaria and other disease endemicity in the area (Peters & Standfast 1957; Peters 1960; Schofield 1962; Schofield & Parkinson 1963; Bailey 1963), and the anthropologist Forge (1970) and geographer Lea (1964) worked in a number of Abelam areas. Other anthropological researchers came
later (Gorlin 1973; Scaglion 1976; Losche 1983; Heuber-Greub, in press; Stocklin, in press) as did the nutritional work by Ross (1984) in the North Wosera.

Male labour outmigration was a major phenomenon in the period from the 1950s until the late 1970s. Most men went to coconut plantations in what are now East New Britain, Madang, and Manus Provinces. By the early 1980s most men had returned to their villages because of fewer work opportunities elsewhere and improved income earning capacity in the village.

Primary health care facilities became more accessible after 1960 when the Assemblies of God mission opened a clinic at Wingei village. Malaria vector control spraying programmes started in 1957, and were already reducing infant mortality rates by the early 1960s (Forge 1970).

The area became a popular missionary environment in the post 1960 period. Apart from the Assemblies of God mission (AOG) which has the largest presence, the following missions operate in the Maprik area: The Catholic Church; Lutherans; New Apostolic mission (NA); Seventh Day Adventists (SDA); South Seas Evangelical mission (SSEM); New Tribes mission (NT); the Baha'i Faith; and the bible translating organisation, the Summer Institute of Linguistics (SIL). Kaberry (1941a:367) saw the potential threat that missionaries posed to Abelam culture and economy:

The missionary who hopes to destroy merely a superstition by excising from the culture the tambaran cult and the ritual associated with yams is in much the same position as a Shylock called upon to cut off a pound of flesh, neither more nor less. Unless the missionary is prepared to accept the responsibility of substituting, and substituting successfully, not only a new religion, but also a new social, economic and political organisation, in short a new society and a new culture, then any interference with the tambaran and yam cults may bring in its train problems that have long proved almost insoluble among other indigenous populations in Oceania, Africa and America.

Unfortunately, Kaberry's warning has not been heeded by most missionaries and significant social, cultural and economic disruption has resulted from selective excision of a number of features of Abelam life.
Socio-cultural change through missionary activity and other sources of general acculturation, together with demographic change because of wartime epidemics and the introduction of medical services, have not all been beneficial to the Abelam. Some of the negative consequences are of a nutritional kind and are discussed in more detail with respect to Gwelikum village in the following chapters.

3.7 Gwelikum village

Gwelikum 2 had a population of 240 people in 1984 and is situated 7 km southwest of Maprik (Figure 3-1). Gwelikum villagers speak the Samukundi dialect but because adjacent Nerikum, Gatnikum and Nindiko villages are Kamukundi speakers and there is considerable social and ceremonial interaction and some inter-marriage, the dialect distinction is not sharp. The 21 hamlets which existed in 1983-84 (mean population per hamlet = 11.5) reflect a post Pax Australiana trend towards more dispersed settlement (Figure 3-2). At the outbreak of WW2, most villagers lived in six larger hamlets, all of which were deserted during the War or soon after.

Between 1958-59 and 1980, the combined population of Gwelikum 1 and 2 villages increased by 52 percent, which is also the overall rate of population increase for the Wora Census District (which includes Gwelikum) for the same period. The reasons are linked to malaria vector control spraying programmes and the introduction of primary health care facilities (Chapter 6). Gwelikum 2 had an overall population density of 72 persons/km² in 1983-84 which is marginally higher than the overall Abelam average of 59 persons/km², but much lower than the nearby North Wosera Census District (average of 150 persons/km²). The adjacent Kamukundi dialect speaking villages of Gatnikum and Nerikum have densities of 146 and 98 persons/km² respectively. Both groups are relatively recent refugees from

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5 Over the years, some exchange of population between the two villages occurred. It is safer to aggregate the two for such gross comparative purposes over time.
Figure 3-1: Gwelikum and environs, 1983-84
Figure 3-2: Gwelikum 2, hamlet locations

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[Map of Gwelikum 2 showing hamlet locations]
warfare in the Wosera, are obviously land-short, and are perceived by Gwelikum as being so.

The Gwelikum physical environment is typical of most Abelam villages. There is no primary rainforest, the last stands having been felled during the 1960s. Related to population growth and extra uses of land for cash cropping has been a sharp reduction in the length of the long fallow (Chapter 8), the formation of more areas of permanent *Imperata cylindrica* grassland, and the loss of forest fauna including wild pigs, cassowaries, marsupials and numerous birds (including some clan totem species). Soils are uniformly of a yellow clay type with shallow A and B horizons. They are prone to waterlogging and to severe cracking during extended dry periods.

Although Gwelikum and Aupik villages adjoin the linguistically different Lehinga Arapesh (Figure 3-1), the sharp linguistic boundary belies the social, cultural, economic, and kinship continuum between the two linguistic groups. Lehinga, Aupik and Gwelikum villagers attend each other's yam displays and other rituals; many older men are bilingual; they share many locally distinctive yam decoration styles and yam nomenclature; there has been some intermarriage; and have formed alliances with each other during warfare in the past. Despite these alliances, Gwelikum and Aupik at one stage turned against Lehinga and ejected them from land on the eastern side of the Amuk river. In 1983-84, Lehinga men assisted with Gwelikum yam planting on this land, and later this labour was reciprocated.

Present day Gwelikum 2 was formerly a village segment. Prior to European contact, the present day villages of Gwelikum 1 and 2 were undivided. Although the two villages were united, in many respects they were separate which provided the Administration with a convenient basis to justify the division. The main differences were (and are) that each segment had its own clans with little clan overlap between the segments; although the land boundary between the two villages is indistinct, the residents of the two villages live on or very close to clan lands; and formerly, the two segments
functioned as de facto villages for competitive *waapi-tscharbera* exchange. The segment presently known as Gwelikum 1 exchanged with Aupik 2; Gwelikum 2 with Aupik 1. Gwelikum and Aupik operate the ara moiety system, but not the general Abelam dual moiety system.

The origins of Gwelikum are unclear but oral traditions suggest a Wosera origin. The adjacent villages of Aupik 1 and 2 are the result of westward expansion by certain Gwelikum clans (and some from other villages) into Arapesh territory. Within the recent past, one Gwelikum clan fled the area and settled amidst Arapesh speaking peoples to the northwest. This clan developed into the present day village of Kuelikum, located near the Arapesh village of Ami. Nelikum village (Scaglion’s field site), north of Maprik town, is believed by both Nelikum and Gwelikum villagers to have originated from emigres from the Aupik area (see Scaglion 1976:49).

Similarly, details of Gwelikum’s first contact with Europeans are unclear, as all people with first-hand accounts are now deceased, but the general image is an unpleasant one. The earliest contacts were made in the now deserted hamlet of Wirapu (Figure 3-2) by German labour recruiters. Present day mothers use the threat of kidnapping by Europeans when disciplining young children so it is tempting to imagine labour recruiting practices not unlike those of the notorious Australian “blackbirders” of the nineteenth century. Notwithstanding the lack of precise detail concerning contact history, there are no data which suggest anything other than the general pattern described by Lea (1964) and Scaglion (1976).

The Gwelikum male:female ratio is 0.8:1.00, and although there is a slight surplus of women over men in the older age groups, the pattern is similar in some of the younger age groups. The difference cannot be explained in terms of male outmigration which had stopped by 1983-84. In addition to the unbalanced sex ratio, the population pyramid shows evidence of changes in demographic processes (Figure 3-3). Ages used in the pyramid are a combination of known (recorded) birthdates (most born after 1960) and
Figure 3-3: Population characteristics, Gwelikum 2, 1983.
estimates calculated by reference to a local calendar of historically recorded events. Of note is the low number of people in the 25-39 year age group who were born between 1944 and 1958. Between 1944-48, the birth rate may have declined because of war disturbance, and the dysentery outbreak in 1944-45 must have increased mortality also. From 1949-58 there was probably a marked reduction in the birth rate due to male outmigration (20-30 year olds). The slight bulge in the 20-24 year old cohort (born 1959-1963) may reflect lower absenteeism during the early War years and hence a higher secondary effect birth rate, but is more likely due to reduced infant mortality through malaria vector spraying with DDT and the introduction of primary health care facilities during those years. The 1959-1963 cohort has probably also had an echo or secondary effect on the 0-4 cohort born between 1979-1984.

The image of a largely intact, traditional Abelam community is illusory. It is true that many elements of traditional life persist in contemporary Gwelikum: traditional houses are still made; ceremonial yams are still grown and many associated belief systems persist; the unending cycle of subsistence gardens cut from long fallow continues; and in general, the overwhelming physical and cyclical sense of Gwelikum is one of tradition and stability. This is only a partial truth. Virtually all aspects of Gwelikum life have been subjected to substantial social, economic, cultural and biological changes since at least the 1930s and especially since WW2.

Contemporary Gwelikum village is a blend of tradition, socio-cultural change, modernisation, and uncertainty regarding the future. The contributions of Gorlin (1973), Gewertz (1983) and Scaglion (1976) to aspects of contemporary Abelam societies are particularly welcome but my image of the contemporary Samukundi village of Kimbangu barely resembles the image produced by Huber-Greub (in press). This is not a criticism of such work but the "pure", "pristine" totality of Abelam life is virtually extinct, and given the problems faced by such societies (eg., health, nutrition, village
level demands for economic development), assessments of contemporary society and culture are surely urgently needed.

A visitor to Gwelikum or any other Abelam village will be struck by the mixture of traditional and contemporary influences on material culture. Apart from the array of house styles, trade stores, and the church structures, Gwelikum has two clubs complete with buildings. One is a women's club sponsored by the East Sepik Council of Women, and apart from the clubhouse which houses a sewing machine, a concrete and iron pig-sty complete with European pigs has been built. The complex is surrounded by a kitchen garden which produces a continuous supply of leafy greens. The other club is in fact a licensed tavern located on the Bainyik-Aupik road. It resembles most similar outlets in the larger towns. It has a bar with a large verandah, and for the benefit of late night drinkers there is a pressurised kerosine lamp which attracts both patrons and moths. The fenced complex is instantly recognisable as a tavern to passing motorists and others.

Built structures are transitory features in the Gwelikum landscape and are not good indicators of history. However, adjacent to some hamlets are machine relics from the 1950s when rice was the promised economic saviour of the village. Hand-made de-husking machines lie rotting where rice growing was concentrated. These are the only physical evidence that rice was ever grown in the village. Micro-organisms and time have virtually erased all evidence of the last spirit house built (last used in the early 1970s) and the large building used to conduct the secret cargo cult business of the Peli Association which flourished in the late 1960s and early 1970s. The only tangible evidence of the former "magic houses" or "yam factories" (a pidgin description of unknown origin) used in yam and taro cultivation are the magic stones themselves which lie ignored on the periphery of some hamlets.

Quite apart from the obvious physical evidence of change, many

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6The road was originally planned to be part of the Sepik Highway but this never eventuated. In dry weather conditions it is a shorter route for east bound vehicles travelling to Hayfield. During the coffee season, the road is relatively busy with up to 10 vehicles using the road per day.
seemingly immutable elements of Gwelikum social and cultural life have changed also. So-called traditional oral histories of the Creation are tinged with post-contact influences. One such blended history includes the (apparently) traditional version of the Abelam Creation involving Waalesaki and Tsiketaakwa and the emergence of Europeans and Abelam people at different times during the Creation. Europeans were created first and had first claim to knowledge and superior technology. The Abelam followed but they only had access to stone tools, digging sticks, and were kept in a state of ignorance of the larger Cosmos. This story provides some insight into Abelam feelings of inferiority following European contact. The Abelam have concepts of wealth creation very different from those of conventional western thought. Europeans are thought by many older Abelam to possess special powers and to have access to the secrets of wealth creation held by the Abelam ancestors. Viewed from the Abelam perspective, the obvious wealth of the few Europeans in the district is a mystery - for example, local Europeans drive expensive cars, eat store-bought foods and want for little yet they don't "work" for this, or certainly the return on their work is much higher than the return for the effort which villagers put into food or coffee gardens. The search for the key to such success is at least part of the basis for the cargo cult. Another example of the "old"/"new" blend concerns the waale. Traditionally, each clan had its own site-specific waale (water spirits or masalai) which inhabit the deeper pools of the numerous small streams. A large water filled WW2 bomb crater is now reputedly the home of one such waale.

Fundamental rules concerning the cultivation of ceremonial yams have either been relaxed, modified to suit the individual, or abandoned altogether. The various dietary prohibitions during the critical yam growing periods (ie., the grower must avoid meat or fish of all kinds, various greens and cold water) are now so variable in practice that they almost defy description. Some men now claim that meat can be eaten but each man should "try first,
then judge its effects on his blood" before making a decision. Others claim that tinned fish and tinned beef should be exempt from the list of prohibited foods. In practice very few men continue to follow all dietary proscriptions. Some men adopt the various proscriptions on a casual basis - one year on, then maybe a one or two year break from serious yam growing. The most serious prohibition however, is the requirement that yam growers abstain from all forms of sexual activity during periods of yam growth. Sexual contact with women has disastrous consequences on yam growth. The two activities are mutually exclusive. So powerful is this sexual prohibition that Scaglion (1978) was able to identify consequent seasonal patterns in births for the village of Nelikum. In order to test the strength of this prohibition and its demographic consequences, I analysed all available birth records \((n=130)\) for Gwelikum 1, Gwelikum 2 and Nerikum villages for the years 1978-84 and found no pattern in the data; in fact, precisely half of the births fall into Scaglion’s "birth season" (October-March) and half into the "non-birth season" (April-September). Although most serious yam growers publicly claim that they abstain from sexual activity at the appropriate time, they privately admit to continued activity. The men who adhere to the prohibitions are too few to influence the larger non seasonal birth pattern.

Not only is the belief system surrounding ceremonial yam cultivation being eroded, but the *raison d'etre* of ceremonial yam cultivation is under threat. Ceremonial yams are central players in the theatre of competitive exchange, both within and between villages. For various reasons, all forms of formal competitive exchange have ceased in Gwelikum and Aupik villages. Inter-village exchange ceased in the early 1970s and intra-village exchange some time later. One of the major factors contributing to the breakdown of the exchange system is the involvement of Christian missionaries in Gwelikum life. The AOG mission has been active in Gwelikum since at least the early 1960s and central to its work is the purging of all "heathen" elements from Gwelikum life. The yam and men’s cults were singled out for attention and
with them, competitive exchange. To a large extent, these objectives have been successful: the yam cults and "yam factories" have ceased to exist; male initiations last took place in the mid 1960s and knowledgable men who can perform these tasks are now few; and finally, competitive exchange has stopped (see Chapter 8 also). It would be a difficult task to revive either form of exchange. In Gwelikum, a substantial numerical imbalance in moieties has developed over time, and this would need to be adjusted before intra-village exchange could recommence. Furthermore, there is considerable reluctance on the part of several important Aupik and Gwelikum men to revive inter-village exchange.

Although traditional yam and pig exchanges have ceased in Gwelikum, elements of the *tschambera* persist via the newer phenomenon of beer drinking. There is a "drinking sub-culture" (a purchasing, credit, grouping, distribution, and consumption protocol exists) which embodies many elements of the *tschambera* exchange system, and competitive beer parties are held. A certain amount of prestige is attached to those individuals or groups who organise large drinking parties (which sometimes include large quantities of pork or beef eaten only by men), some of which may last for 2 or 3 days. In these circumstances, the men have committed themselves to this exchange system, and is thus traditional in a sense - money is handed over to the men by their wives (who hold the money) even though most women object to the large amounts (47 percent of all income) spent on beer. Gwelikum "big men" regard beer as "female" and "cold" and include it in the range of foods and pastimes prohibited in the critical growth phases of ceremonial yam cultivation.

There has been some partitioning of the Gwelikum parish by the two missions. The AOG mission insists that a certain behavioural code be adopted before a person is welcomed into the church and may be baptised ("born again"). Smoking, chewing betel-nut, drinking alcohol, and various social and traditional activities are prohibited. Older people have not been
attracted by these restrictions, and most AOG successes are found amongst
the young. The AOG mission has a very high profile in Gwelikum and holds
services on most days of the week. The NA mission has a very different
clientele. Most members are older, and many are former officials of the Peli
Association - indeed, the church seems little more than a new cargo cult. Of
the younger members of the NA mission, the observer is left with the
unavoidable conclusion that it has attracted many of Gwelikum’s losers and
"rubbish men". As part of strengthening its niche in the village, the NA
mission places few behavioural restrictions on members. It does however,
suspend and impose fines on members who have been successful at cultivating
ceremonial yams, thus conceding the power of supernatural forces and magic!

In addition to the two missions dividing up the village between
themselves, a number of social divisions have been created or reinforced by
their presence, particularly the AOG mission. Four broad functioning groups
have emerged within the village. Those men (and their families) who continue
to practise most aspects of traditional life are now more peripheral in terms
of direct power and influence. They are certainly in the minority, and
associate with like-minded men of Aupik, Apangei and Nindiko villages, and
individuals informally exchange yams. Their remaining influence lies in
setting the gardening calendar. Young men will not plant food gardens before
the “big men” have planted their ceremonial yams and started planting the
main food gardens. The AOG Christians comprise the second group. They
are younger and associate with Aupik, Nerikum and Hayfield AOG groups.
Because they observe AOG rules, and in particular do not smoke or chew
betel-nut (both are important social lubricants), and are advised against
“heathen” practices, they tend not to interact as much with the other groups.
For many such Christians, the stresses associated with this self-imposed social
isolation are too much, and many leave the mission, some temporarily, others
permanently.

Two lesser but nonetheless noticeable social groups exist also. During
the coffee season when cash is abundant, a group of card playing men forms. They live nocturnal lives which alternate between playing sessions at Maprik village, Gwelikum or Nindiko. Most beer parties are organised by men from this group. The final distinctive group is the business-oriented sector of the village. These men are neither necessarily traditional nor Christian (but some are). Their lives centre on schemes to introduce economic development to Gwelikum. Like the Christians, some abandon their dreams, for economic development and wealth derived from cash cropping are hard to achieve in Gwelikum. Some business oriented men were formerly Peli Association officials who appear to have abandoned overt cargo thinking; others are younger men who regard the yam obsessions of their fathers as quaint, misguided and inappropriate to modern life. Some of these younger men have attended school (to year six) but few have worked away from the village. Schooling is a phenomenon which has largely passed Gwelikum by. Participation rates are low, certainly lower than in adjacent Aupik. The reasons for this are unclear to me, but the "education ethos" is weak. I formed the impression that many of the more intelligent children who may have started school, tend to drop out very early, preferring to be free agents in their own domain. Such children are called bikhet (disobedient, stubborn, maverick) in pidgin, a trait in older boys which is considered acceptable and even quietly encouraged.

The mechanisms for resolution of conflict have altered substantially in Gwelikum. The many causes of conflict or disputation centre on women, land, theft, appropriation of sago or coconut resources, and sorcery. Sorcery accusations are now rare but were formerly common causes of conflict. Scaglion (1976) discussed the range of options (in hierarchical fashion) for resolving conflict and these also apply in Gwelikum. The most common approach is simply talking the problem out (kundi). Kundi may result in the exchange of yams, money and shell-rings, which may either terminate or non-violently attenuate the dispute. A newer phenomenon is the settlement of disputes by beer exchanges or compensation in the form of beer gifts. In
many respects, beer is the "new yam" and is a highly visible component in Gwelikum life, particularly during the coffee season when cash is abundant. Beer drinking often brings deep grudges and disputes to the surface, so it may either precipitate disharmony or play an important role in the resolution of conflict. Fighting, a rarer and generally less satisfactory method of resolving conflict, usually initiates a new cycle of kundi and yam/ring exchange.

Newer elements in conflict resolution include the village councillor and the village court. Scaglion (1976) emphasised that traditionally, conflict types and conflict resolution were reflected in seasonal patterns. Ceremonial yam growing demands harmony and the minimisation of conflict. The non-growing season (also the ceremonial season) is also a period of heightened tension and institutionalised aggression. In Gwelikum, the belief systems associated with yam cultivation have been substantially eroded and conflict types and frequency now assume a weaker or possibly non-seasonal pattern. Although kundi is very important, the court system is increasingly relied upon to resolve conflict - even in seemingly frivolous or vexatious cases. To some extent, the court system as practised in Gwelikum is really only institutionalised kundi but the magistrate can and frequently does make arbitrary decisions which are not always satisfactory to all parties. Further, the court hearing often involves a delay between the time of the dispute and its resolution which may create tension between the parties. The magistrate (a man elected from within the village) is frequently accused of bias or poor judgement so in many cases further, more informal, kundi, is used to ultimately resolve conflict. In theory, the councillor can assist in conflict resolution, but Gwelikum has a history of electing token or ineffective men to this office. The councillor's authority is rarely taken seriously, and indeed, the impression is that his election is the collective, cynical response by the village population to external intervention in Gwelikum's affairs.

The persistence of ceremonial yam (waapi) cultivation by most men
over 30 years of age is related more to the role of yams in conflict resolution than it is to "belief in the *waapi*". Many younger men are most reluctant to grow ceremonial yams but as one "big man" said to me

...it doesn't matter what these young men think about *waapi*, the simple fact is that in our world, the *waapi* is still central to things like "trouble", when a person dies, and discharging debts. The *waapi* is everything.

Most young men reluctantly agree, recognising that their capacity to maintain harmonious relations within the village rests to a large extent on ceremonial yam cultivation.

Male-female relations are undergoing transformation within Gwelikum. Kaberry (1941), Lösche (1983), Forge (in press) and Huber-Greub (in press) have commented on the importance of gender complementarity in Abelam society. Huber-Greub (in press) considered that

...in spite of the real economic and social position of women there is an idea of mutuality and complementarity of the sexes in a deeper sense...The Abelam recognise complementarities between different things and beings, between men, ancestors, spirit beings, animals, plants and things...Amongst all possible complementarities recognised by the Abelam the one between men and women is the most essential. It is the necessary starting point and foundation of successful, satisfying, productive social life in general.

In Gwelikum, the normative idea (as distinct from the reality) of complementarity of the sexes differs between younger and older men. A constant theme arising from my observations of older Gwelikum couples was that of gender complementarity; in younger couples, the theme of opposition and exploitation by men of women emerged. This latter observation however, may be inaccurate over time - perhaps these younger men eventually learn to perceive women as their fathers do. Certainly however, my impression is that the idea of women's position is now much closer to the reality. Older men also recognise the shift in male-female relations and lament the increasing violence directed at women and general disregard for them. Most marriages are monogamous. A small number of mainly older men have two wives; none have more than two at a time. Polygamy is unpopular, mainly because of the tensions between the wives.
Children are everywhere in Gwelikum and are clearly very much a part of normal life. They are indulged and it is common to see very young children very close to their parents. In this regard, the attitudes of parents towards children noted by Kaberry (1941a, 1941b) has probably changed little. Children as family members, and Abelam perceptions of the child, are discussed in more detail throughout this thesis.

Gwelikum’s younger men, and to a lesser extent women, are truly impoverished when compared with their parents. Their fathers know more about traditional customs and laws, and for them village life has meaning and purpose, yet they are also men of the world who have been away from the village and experienced it all; now they are back and their lives are enriched. The sons however, have not even been initiated into the men’s cult and may never be; their wider knowledge of village life and their understanding of their purpose in life is limited. The second rite-of-passage - the labour contract - has eluded most young men also. And a final frustration to some is that they have been tantalised a little by the “other world” through basic education. Unfortunately, such an education has created some degree of dissatisfaction with village life and slow economic growth has not absorbed would-be job seekers into the work force. In a sense therefore, the villager of the period from the mid 1950s until the mid 1970s experienced much more of life from both worlds than has been possible for the young adult from the mid 1970s onwards.

Today’s younger villager is impoverished in terms of knowledge and experience. Knowledge of many traditional practical skills is rapidly disappearing. Only two men still make the intricate woven yam masks. No men can make the large baapataakwa (tumbuan) masks used in the waken (male initiation) ceremony. There are no skilled wood carvers and only one man knows how to prepare the facade of the spirit house. The special snares (amb’wut and baalewut) used to trap bandicoots and pigs must now be purchased from Lehinga or Amahop villages. Other kinds of knowledge rapidly
disappearing are: the range and use of traditional medicines; spiritual aspects of healing; and some infant feeding methods. Some cooking methods are poorly known and rarely used, and the gathering of wild forest foods is becoming less popular.

Absentee men who returned to Gwelikum not only came back as different, more worldly men, but brought back new cultural, culinary and subsistence knowledge. Some men were even initiated into the men's cults of foreign villages. The now commonly eaten sago jelly dish in Gwelikum was introduced by returning indentured labourers. Even a significant number of songs, melodies and rhythms performed at contemporary ceremonies derive from foreign parts. Occasionally, motifs painted on spirit houses are of marine fauna such as sharks, marlin or turtles. Returnees brought back various cultivars of taro, bananas and yams, and indeed, one of the most commonly planted cultivars of D. alata (the variety *missionwaapi*) is a recent introduction from the Madang coast. *Sanguma* sorcery is an introduction also. It may have originated in the Dreikikir area (west of Maprik), and adopted by Abelam men who were in contact with Dreikikir men in the Maprik area or at the coast.

There is an increasing trend towards insularity and introspection within Gwelikum which is partly attributable to the nature of the newer generation of young people, but it also reflects a rejection of introduced ideas and less willingness to be innovative (see Chapter 9 for a discussion of the implications of this). Younger people are xenophobic, particularly towards the Arapesh - quite unlike their fathers who are at ease with their Lehinga neighbours. Gwelikum has experimented with many introduced concepts, techniques and enterprises since the early 1950s. Various exotic fruit trees

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7. So "different" is the returnee that when a person is about to leave the village for the first time and for an extended period, a wake is held on the eve of departure. In many respects, it is a true wake as the emigre "dies" upon leaving and upon returning is a "new" or different person.

8. In 1984, the new spirit house at Nindiko depicted such fauna in addition to conventional Abelam features.
were planted in the past - there are no new plantings today and much of the produce is either left to rot, eaten only by children, or perhaps sold at Maprik market. Cattle, commercial poultry for meat and eggs, and piggeries have been tried and all have failed. There is widespread concern within the village over the lack of economic opportunities. Cacao is the latest attempt to boost village incomes but a re-entry into livestock production is understandably unpopular. Poor returns, the ongoing need for fence maintenance, the destruction of food gardens by rogue cattle, increasing perceptions of land shortages and the nature of land tenure have made cattle projects unpopular. Cognisance of land tenure principles, practice and problems is essential when promoting land-demanding schemes such as beef cattle husbandry. In the past, cattle projects have been promoted in the densely populated Maprik area and have apparently ignored the land tenure problems which provide obstacles to land aggregation, a necessary condition for a stable, long-term cattle project. Similarly, the cargo cult approach is unpopular in Gwelikum (except among some older men associated with the New Apostolic church). The Peli Association of the late 1960s and early 1970s captured the imagination (and money) of most villagers. Nevertheless, cargo thinking is widespread, is implicit in wealth creation concepts, and indeed a full-scale cargo cult could possibly emerge in the future if the circumstances are right. One man's comments reflect this possibility:

We have tried many cargo roads before but none have produced the promised cargo. I am tired of trying but if another idea comes up which sounds better, then I will try again. This one (referring to the NA church)? Well, I don't think so...not yet.

Many Gwelikum people recognise some of their emerging problems. They are faced with rapid population growth, declining environmental quality, and an increasing awareness of their own poor health and nutritional problems. In short, many see themselves in a state of poverty, a perception which goes well beyond the cultural inferiority syndrome felt by many Melanesians. There have been significant social, cultural, and economic changes in recent
years but none have led to the substantial improvements to their material standard of living which they would like. Economic opportunities are virtually non-existent and the cargo road has not fulfilled its early promise. There is a general air of insularity, despondency, and disenchantment with their circumstances - and no local solutions are forthcoming. In many ways, my observations have a *deja vu* atmosphere and read like an updated version of the North Wosera accounts by Forge (1963), Lea (1965), and Oxer (1965). These, then, are the general circumstances of Gwelikum and the context of contemporary child malnutrition.
CHAPTER 4

GROWTH IN THE EARLY YEARS

Gwelikum infants\(^1\) grow quickly during their first few months of life but after about 6 months, their growth performance (for all growth indices) markedly deteriorates. Growth remains poor until about 24 months, after which some improvements occur. Growth in length however, does not fully recover and reflects a long-term trend towards stunting (i.e., low length-for-age). In general, the "average" Gwelikum under five year old grows at a level which may be termed as "slightly malnourished" or close to being defined as such. The more severe clinical malnutrition syndromes \textit{kwashiokor} and \textit{marasmus} are rare in Gwelikum - indeed, few cases are seen at the Maprik Hospital malnutrition ward. There is some evidence of a seasonal dimension to growth, but it is a relatively small component of overall growth variability and declines with increasing age. In addition to growth variability over time, there are some minor spatial differences (i.e., inter-hamlet) in growth patterns. The spatial occurrence of the skin disease \textit{Tinea imbricata} is relevant in explaining some of these differences.

It is important to emphasise that although Gwelikum 1 and 2 growth data are aggregated, the overall sample remains small (n=98), thus increasing the likelihood of high variability. This is particularly so in some age subgroups where sample size is very small. Nevertheless, the general statements about growth in Gwelikum under fives can be demonstrated from the anthropometric and other data.

\(^1\)Hereafter "infants" refers to children aged between 0-6 months; "toddlers", 7-24 months; "weaned toddlers", 25-48 months; "older children", 49-60 months.
Plate 4-1: Gwelikum under fives
4.1 A Note on Growth Standards

There are a number of methods of assessing nutritional status. In this thesis growth is evaluated using two measured parameters: body weight and length. When considered separately in relation to chronological age or in relation to each other, three indices are generated: weight-for-age (W/A), length-for-age (L/A), and weight-for-length (W/L). As these indices are relative, and in the absence of Papua New Guinea growth standards, the Harvard standards (Jelliffe 1966) have been adopted.

The Harvard standards (the median for a large North American sample) may be inappropriate for use in Papua New Guinea since their sample base has quite different genetic, socio-economic and environmental circumstances from those of Papua New Guinea. The somewhat arbitrarily defined cutoff points for what constitutes a “malnourished” or “severely malnourished” child may well be inappropriate for Papua New Guinea but this should not necessarily invalidate their use. An IMR objective is to redefine the Papua New Guinea cutoff points in relation to the Harvard standards, this redefinition being functionally derived (Heywood 1979). At present, a child is regarded as moderately malnourished in Papua New Guinea if its weight is less than 80 percent of the standard weight for age of a child of that chronological age. But,

its disadvantage [ie., W/A] is that it does not distinguish between past nutritional history and current nutritional status. A child may have low W/A because it has low L/A and normal W/L, low W/L and normal L/A, or both L/A and W/L (Harvey and Heywood 1983:13).

Waterlow (1972, 1976) considered two basic dimensions in nutritional status—the concepts of stunting and wasting. A child whose L/A falls below 90 percent of the Harvard standard is classified as stunted, and wasting refers to the child whose W/L is below 80 percent of the Harvard standard. Weight-for-length is an index which expresses actual body weight in terms of

\footnote{If that is possible given the physical heterogeneity of the Papua New Guinea population (see Heywood & Nakikus 1982).}
expected body weight, given its length. A child with an 80 percent W/L measure is therefore one whose weight is only 80 percent of the expected weight for a given length. It is really a measure of how a child is proportioned and is thus, when used in conjunction with the L/A index, a good indication of the antecedent short and long term nutritional conditions experienced. Chronic, long term malnutrition is reflected by stunting, whereas episodic or more recent malnutrition tends to present as wasting. Waterlow's (1972, 1976) emphasis on the distinction between stunting and wasting has led to wide use of the so-called "Waterlow Classification" in describing the extent and type of malnutrition in a child population. A child may be one of the following:

- normal
- wasted but not stunted
- stunted but not wasted
- stunted and wasted.

For any sample or population, a Waterlow classification is easily produced and a very detailed Waterlow classification can be produced if wasting and stunting are graded according to severity.

Malnutrition can be functionally defined. It has been demonstrated for a number of populations that malnourished children are more likely to become sick and are at greater risk of death (Mata et al 1975; Mata 1978; Binns 1976b; Heywood et al 1981; Heywood 1983). Quantifying the nutritional level below which morbidity and mortality become significant is an IMR objective. An example is the work of Heywood (1981) which demonstrated that mortality risk in a highlands population increased in stunted under fives (<90% L/A), and if combined with moderate wasting (<90% W/L), the mortality risk was even higher.
4.2 General growth characteristics and the Harvard standards

The first five years of life in Gwelikum are typical of the general pattern for many Papua New Guinea communities (Wark and Malcolm 1969; Malcolm 1970; Sinnett 1977; Wyatt & Wyatt 1978; Harvey and Heywood 1983; Ross 1984).

The period from birth to six months is a time of relatively rapid growth, during which most children exceed 90 percent of the Harvard standards for W/A and some exceed 100 percent (Figures 4-1 & 4-2). Between about 8 months and 24 months of age, W/A falters with most Gwelikum children below 80 percent of the standard. Thereafter, W/A improves and by 60 months, the mean W/A is just below 90 percent of the standard.

The pattern for L/A is somewhat different from W/A in that there is a much more gradual decline in L/A and a more gradual recovery. The general pattern is one of decreasing L/A over time and reflects the longer term outcome which is very short stature as adults (Gwelikum men average 158.5cm and women, 149cm). The L/A curve indicates a tendency towards slight stunting in the longer term.

The W/L pattern reflects an early trend (0-6 months) of favourable W/L relationships but as with W/A, this quickly deteriorates between 8 and 18 months indicating a major period of relative wasting. This arises from a rapid decline in W/A and a slower decline in L/A. Thus, children continue to grow in length (but at a slightly slower rate) but become thinner as they do so. After about 24 months, W/L improves as W/A improves and the decline in L/A is arrested. W/L continues to improve and by about 48 months, most children are close to about 100 percent W/L. Between 49 and 60 months, mean W/L exceeds 100 percent. Thus, these children once again achieve weights which are commensurate with their heights. Wasting is no longer the problem that it was between 7 and 18 months of age. Although the children eventually achieve a satisfactory W/L relationship, they are mildly stunted as a group, and their new found plumpness belies this fact.
Figure 4-1: General Growth Patterns (Mean W/A, L/A & W/L), 0-60 Months, Gwelikum 1 & 2.
Figure 4-2: Growth Curves (Mean Weights and Lengths), 0-60 Months, Gwelikum 1 & 2
The above description clearly highlights particular times during a child's first five years when it is likely to experience possible periods of wasting and stunting. A more general statement about the relative importance of wasting and stunting emerges from a "Waterlow classification" of under fives (Table 4-1).

Table 4-1: Occurrence of Protein Energy Malnutrition using Waterlow's Classification, Children 0-60 months, Gwelikum 1 & 2 Combined, Number (percent).

<table>
<thead>
<tr>
<th>W/L</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 80%</td>
<td>&lt; 80%</td>
</tr>
<tr>
<td>L/A &gt; 90%</td>
<td>NORMAL</td>
</tr>
<tr>
<td>53 (54)</td>
<td>8 (8)</td>
</tr>
<tr>
<td>&lt; 90%</td>
<td>STUNTED</td>
</tr>
<tr>
<td>35 (36)</td>
<td>2 (2)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>88 (90)</td>
</tr>
</tbody>
</table>

Note:

Based on anthropometric data for September 1984.

To some extent, the Waterlow classification belies the significance of wasting in particular age sub-groups - most toddlers are either wasted or nearly so - but it does highlight the importance of stunting in Gwelikum.

4.3 Growth in relation to Gwelikum "standards"

If the W/A, W/L and L/A values are converted to standard scores (ie., z scores) which are calculated using only the data from Gwelikum 1 & 2, it is possible to derive an image of "normality" for Gwelikum and to examine how individuals at different ages perform in relation to this norm (which is the average for the group). Mean Gwelikum W/A is very close to the level for definition as "moderately malnourished" (< 80 percent of the Harvard standard); mean W/L is 93 percent of the standard which is just above the level for "mild wasting" (< 90 percent of the Harvard standard); and mean
L/A 92 percent of the standard - only 2 percent above the accepted level for stunting (Figure 4-3). At different ages children may be above or below the "local" standards, but the fact that Gwelikum "standards" so closely approach accepted definitions of malnutrition is significant in terms of local perceptions of what constitutes a normal or abnormal child (see Chapter 7).

4.4 Seasonal and other temporal characteristics of early childhood growth

Although one year is too short a time series to adequately evaluate the role of seasonal dimensions to factors influencing growth in the under fives, an assessment of the data nevertheless reveals that growth rates are not constant over time in Gwelikum. Prior Abelam research has also shown that body mass in adults (Lea 1964; Whiteman 1965) and children (Whiteman 1965) is not seasonally stable\(^3\) and that the seasonally variable food supply may be the main reason for this.

Four age sub-groups within the under fives are used in the analysis, approximating to commonly used "natural" developmental and Abelam feeding regime groups. These are:

- infants (0-6 months)
- breastfed toddlers receiving supplementary feeding (7-24 months)
- mainly weaned toddlers and younger children (25-48 months)
- older, more self-reliant children (49-60 months)

As with general growth patterns, W/A, L/A and W/L are the main indices used to describe growth patterns over time of Gwelikum under fives.

During my fieldwork, January 1984 until March 1984 was a particularly noteworthy period of rapid changes in weight increments. I had noticed that many children made little or no weight progress between January and February 1984, but from February to March 1984, sudden and significant

\(^3\)Results of Gwelikum adult anthropometry for two dates (Feb 1984 and July 1984) revealed that there were no significant differences in mean weights of men or women. Full details are in Appendix A.
Figure 4-3: Growth Patterns (Z Scores - W/A, L/A & W/L), 0-60 Mths, Gwelikum 1 & 2. Harvard Standards also shown.

Weight for Age

Length for Age

Weight for Length
weight increases occurred. This field observation was confirmed by subsequent analysis (Figure 4-4). Only those under fives with a complete set of monthly weight records (ie., 11 entries) were selected for this analysis. Between December 1983 and January 1984 mean actual daily growth was very high but fell away dramatically between January and February 1984. Between February and March 1984 growth increments were again very high but after that, growth declined to a low between April and May. Thereafter, growth increments slowly rose but by September the mean daily increments had not reached the earlier peaks.

The seasonal contribution (Figure 4-6) to overall growth variability (Figure 4-5) for the various sub-groups is relatively low (approximately 20 percent). The higher total variance and proportions attributable to seasonal factors in the 0-6 months and 49-60 months groups is an artifact of the small sample size in these two groups and does not reflect greater seasonal vulnerability in growth fluctuations. Length for age has the lowest overall variability (ie., most children are alike), and as expected, the lowest proportion of this small variability attributable to seasonal factors. Thus, although there is considerable variability in the W/A and W/L growth indices, most of this is due to individual variability rather than seasonal factors.

By extending the analysis of the 19 children (see Figure 4-4) to the main indices of W/A, and W/L (excluding L/A) for all Gwelikum 1 and 2 records and stratifying by age groups it can be demonstrated that growth characteristics vary in these age groups over time. Mean W/A, and W/L values for each age group have been converted to standard scores in order that the growth index can be assessed, for any month, as being above, below or at mean growth performance for that age group for the time series under consideration (Figure 4-7).

Identifying trends or patterns from the raw data in Figure 4-7 is difficult however. If the same data are considered in terms of improvement,
Figure 4-4: Mean Weight Increments, 19 Under Fives, Gwelikum 2, October 1983 to September 1984.
Figure 4-5: Total Growth Variance ($\sigma$), W/A, L/A & W/L, By Age Class, Gwelikum 1 and 2 Separately.
Figure 4-6: Percent of Total Variability in W/A, L/A, & W/L Attributable to Seasonal Factors, by Age Group.
stability or decline relative to the previous month, a slightly more precise overview of trends is possible (Table 4-2). Growth is considered in terms of three criteria (for each month). These are:

- Growth which is well above average (i.e., greater than one standard deviation above the mean) and/or has increased markedly from the preceding month.

- Growth which is close to the average growth and/or has not changed or has changed little from the preceding month.

- Growth which is well below average (i.e., greater than one standard deviation below the mean) and/or has decreased markedly from the preceding month.

When the age groups are aggregated and the growth indices ranked, an overall summary emerges (Table 4-3).

January and June 1984 were poor months for both growth indices. March was the best month overall but September was a good month for W/A and W/L. October and November 1983 were poor months for W/A and W/L. The possible reasons for these apparent trends are discussed in the next chapter.

4.5 Hamlet location and nutritional status

A further growth dimension to examine is the possibility that spatial patterns may exist. Is the overall, average pattern evenly located in space or are there pockets or groups of well nourished, poorly nourished or "normal" children?

Gwelikum hamlets are small, and the number of under fives in each hamlet was very small (mean=3.0 per hamlet), thus numerical analysis of the distribution of malnourished children is meaningless. Most Gwelikum 1 and Gwelikum 2 hamlets had much the same combination of well-nourished and malnourished children, but there were two exceptions to this general pattern. In Gwelikum 1, a group of geographically and genetically close hamlets had 16 under fives, of whom 10 were malnourished (9 stunted, 1 stunted and wasted). In another larger hamlet, there were 11 under fives, and 7 of these
### Table 4-2: Summary of Temporal Growth Trends, W/A & W/L, By Age Group, Gwelikum 1 & 2 Combined. Rank of Most Significant Month(s).

<table>
<thead>
<tr>
<th>Age Group (months)</th>
<th>Months</th>
<th>Well Above Ave. (1)</th>
<th>Normal/Ave.</th>
<th>Well Below Ave. (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–6</td>
<td>March</td>
<td>Sept</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>7–24</td>
<td>March</td>
<td>–</td>
<td>June</td>
<td></td>
</tr>
<tr>
<td>25–48</td>
<td>March/Sept</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>49–60</td>
<td>–</td>
<td>Sept</td>
<td>–</td>
<td></td>
</tr>
</tbody>
</table>

(B) W/L

<table>
<thead>
<tr>
<th>Age Group (months)</th>
<th>Months</th>
<th>Well Above Ave. (1)</th>
<th>Normal/Ave.</th>
<th>Well Below Ave. (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–6</td>
<td>March</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>7–24</td>
<td>March</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>25–48</td>
<td>March/Sept</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>49–60</td>
<td>March/Sept</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**

(1) Greater than one standard deviation above or below mean.
Table 4-3: Summary of Temporal Growth Trends, W/A & W/L, All Age Groups Combined, Gwelikum 1 & 2 Combined. First and Second Ranked Months Shown.

<table>
<thead>
<tr>
<th>Growth Performance</th>
<th>Rank</th>
<th>Growth Index</th>
<th>W/A</th>
<th>W/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best Months</td>
<td>1</td>
<td>March</td>
<td>March</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Sept</td>
<td>Sept</td>
<td></td>
</tr>
<tr>
<td>Average/Little Chge.</td>
<td>1</td>
<td>Sept</td>
<td>June</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>June</td>
<td>Nov/Sept</td>
<td></td>
</tr>
<tr>
<td>Worst Months</td>
<td>1</td>
<td>Oct/Jan/Jan</td>
<td>June</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Nov/Dec</td>
<td>Oct/Nov/Jan</td>
<td></td>
</tr>
</tbody>
</table>

were malnourished (6 stunted, 1 wasted). This uneven spatial distribution of malnourished under fives was no accident - both hamlet groups were Gwelikum's *Tinea imbricata* clusters (see Chapter 6 also).

Apart from the uneven distribution of *Tinea imbricata* and its possible relationship to child nutritional status, there are no apparent inter-hamlet (or kin or clan cluster) differences in nutritional status.

4.6 Summary

From the analysis of general growth patterns a number of general statements may be made:

1. Child growth is good in the first few months of life.

2. Irrespective of season, growth is poor from 7-24 months of age - for all growth indices.

3. After about 24 months of age, W/A and W/L recover, but the long term trend is one of sub-optimal growth - as evidenced by the trend towards stunting (ie., low L/A).

4. Mean growth parameters for Gwelikum children are remarkably close to the levels adopted for defining malnutrition in Papua New Guinea, so the "normal" Gwelikum child is likely to be slightly malnourished or at least close to being defined as such.
5. In terms of growth variability there are seasonal contributions to total variability but this seasonal component declines with increasing age.

6. There are seasonal variations in growth performance but these are not (in the toddlers who are typically wasted) a major variable in growth dimensions.

7. There are few anthropometric differences between hamlets. Some however, are distinctly at variance with the main group cluster, and reflecting the spatial occurrence of the disease *Tinea imbricata*.

Thus, from the anthropometric data, the average under five year old experiences three types of growth performance: a good early start; a rapid and severe period of wasting as a toddler; and a gradual but incomplete growth recovery thereafter. This suggests three processes - factors causing decline in nutritional status after a good growth start; some shorter-term processes which ensure that wasting is maintained for most of the toddler period; and processes which lead the child out of a wasting phase but which are still insufficient to prevent longer-term mild stunting. The reasons for the onset, maintenance, and weakening of these processes form the basis of much of the analysis in the following chapters.
APPENDIX A

ADULT ANTHROPOMETRY

1. General anthropometry

<table>
<thead>
<tr>
<th>Age class (yrs) &amp; number</th>
<th>Mean Weight (SD) in kg.</th>
<th>Mean Height (SD) in cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(a) Men</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-39 (n=16)</td>
<td>59.9 (6.3)</td>
<td>165.3 (4.7)</td>
</tr>
<tr>
<td>30-39 (n=3)</td>
<td>52.2 (4.6)</td>
<td>157.3 (5.3)</td>
</tr>
<tr>
<td>40-49 (n=9)</td>
<td>56.2 (7.6)</td>
<td>158.7 (7.4)</td>
</tr>
<tr>
<td>50-59 (n=6)</td>
<td>54.2 (8.7)</td>
<td>159.0 (4.9)</td>
</tr>
<tr>
<td>&gt; 60 (n=8)</td>
<td>49.6 (4.7)</td>
<td>155.8 (5.8)</td>
</tr>
<tr>
<td><strong>(b) Women</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-29 (n=12)</td>
<td>52.7 (4.8)</td>
<td>151.0 (6.4)</td>
</tr>
<tr>
<td>30-39 (n=8)</td>
<td>46.4 (8.2)</td>
<td>149.3 (7.3)</td>
</tr>
<tr>
<td>40-49 (n=3)</td>
<td>44.7 (6.4)</td>
<td>151.8 (1.3)</td>
</tr>
<tr>
<td>50-59 (n=6)</td>
<td>44.7 (6.0)</td>
<td>148.3 (9.2)</td>
</tr>
<tr>
<td>&gt; 60 (n=2)</td>
<td>41.8 (0.4)</td>
<td>147.8 (5.3)</td>
</tr>
</tbody>
</table>

2. Seasonal changes. Mean weights (SD) in kg.

<table>
<thead>
<tr>
<th></th>
<th>Feb 1984</th>
<th>July 1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>All men (n=37)</td>
<td>57.2 (7.3)</td>
<td>57.4 (7.0)</td>
</tr>
<tr>
<td>All non-pregnant</td>
<td>46.2 (6.7)</td>
<td>46.8 (7.2)</td>
</tr>
<tr>
<td>women (n=36) (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactating women</td>
<td>50.3 (3.4)</td>
<td>50.0 (3.6)</td>
</tr>
<tr>
<td>(n=7) (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nulliparous women</td>
<td>46.8 (7.4)</td>
<td>47.6 (8.1)</td>
</tr>
<tr>
<td>(n=12)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-lactating mothers</td>
<td>44.1 (6.6)</td>
<td>44.3 (7.2)</td>
</tr>
<tr>
<td>mothers (n=17)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:

(1) All women were non-pregnant on both occasions.

(2) All women were lactating on both occasions.
APPENDIX B

CHILD ANTHROPOMETRY

<table>
<thead>
<tr>
<th>Age group (mths)</th>
<th>W/A (1)</th>
<th>L/A (1)</th>
<th>W/L (1) (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>X</td>
<td>SD</td>
</tr>
<tr>
<td>0–6</td>
<td>33</td>
<td>91</td>
<td>13.9</td>
</tr>
<tr>
<td>7–12</td>
<td>39</td>
<td>76</td>
<td>10.5</td>
</tr>
<tr>
<td>13–18</td>
<td>48</td>
<td>75</td>
<td>10.7</td>
</tr>
<tr>
<td>19–24</td>
<td>39</td>
<td>76</td>
<td>8.7</td>
</tr>
<tr>
<td>25–30</td>
<td>61</td>
<td>79</td>
<td>9.0</td>
</tr>
<tr>
<td>31–36</td>
<td>57</td>
<td>79</td>
<td>9.3</td>
</tr>
<tr>
<td>37–42</td>
<td>38</td>
<td>81</td>
<td>9.3</td>
</tr>
<tr>
<td>43–48</td>
<td>30</td>
<td>86</td>
<td>10.2</td>
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<tr>
<td>49–54</td>
<td>26</td>
<td>88</td>
<td>9.9</td>
</tr>
<tr>
<td>55–60</td>
<td>29</td>
<td>88</td>
<td>10.8</td>
</tr>
</tbody>
</table>

Notes:

(1) Numbers represent all records for each child whilst in that age group. Gwelikum 1 and 2. Total children=98.

(2) W/L data from Gwelikum 2 only.
CHAPTER 5

PATTERNS OF DIETARY INTAKE

5.1 General nature of the food supply

The Gwelikum diet is virtually wholly vegetarian and is based mainly on tuberous garden staples, bananas, sago, and various leafy greens. There is very little animal husbandry and the few village pigs and chickens, when slaughtered, are eaten at ceremonial occasions. Village chickens are poor egg producers and because of high predation of poultry by snakes and dogs, hens are allowed to hatch their eggs. Hunting and gathering contribute little to dietary intake. Store-bought foods are a minor proportion of foods eaten.

There is a marked seasonality in the types of food available, reflecting the gardening cycle which is regulated by the wet/dry season climate. The consumption of store-bought foods has a seasonal pattern also because of the seasonal nature of coffee production, the main cash source. The Abelam divide the year into a "lean period" (termed kwitule) and a "season of abundance" (katule). The terms do not reflect absolute food shortages but refer to the periods when yams and taro are scarce or abundant. In general, the "lean period" starts in about December and may last until June or July, but varies according to local conditions (Figure 5-1). Most of the "lean period" thus straddles the later part of the wet season and extends into the dry season. The "lean period" is dominated by sago and banana based meals, and the "period of abundance" by yams and taro. Cash availability usually peaks in the dry season and in Gwelikum this is well timed as most garden foods are in relatively low supply during the coffee season.

The general impression is one of food abundance, even during the "lean period". General food abundance however, belies the special problems that
Plate 5-1: Cooking methods, above, roasting, below, boiling
Figure 5-1: Traditional "lean periods"

<table>
<thead>
<tr>
<th>Months noted</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
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<td>1983</td>
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<td>1983-84</td>
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</tbody>
</table>

SOURCE
- Kaberry (1941a)
- Stent (1963)
- Lea (1964)
- Whiteman (1965)
- Scaglion (1976)
- Losche (1983)
- Ross (1984)
- This Study

"Lean Period": yams in short supply; meals dominated by other staples (esp. sago)
under five's experience with the Gwelikum diet. Because of the bulky nature of most staples, young children must consume large quantities in order to adequately meet dietary needs (Binns 1976a). In addition to this inherent bulk-density problem, there are seasonal variations in bulk-density in line with the variations in types of staples eaten. The sago dominated months, which approximate to the "lean period", are low energy and protein intake months because of the lower energy and protein values of the sago meals prepared.

Apart from the general bulk-density problem, there are protein quality difficulties with the Abelam vegetarian diet. Most plant foods do not contain "complete" proteins, unlike most foods derived from animal sources. The lower quality of most vegetable proteins is due to either absence or inadequacy of particular amino acids (the components of protein). Such amino acid deficiencies have a limiting effect on the others which may be present in adequate amounts (Guthrie 1979). Some plant foods (eg., soy beans and nuts) "...contain some of all the essential amino acids but are sufficiently limited in one or more that they are less effective than most animal proteins in meeting needs for growth" (Guthrie 1979:71). Yams (of the species *D. esculenta*) have a poor amino acid balance with the amino acids methionine and cystine low and limiting and lysine and tyrosine somewhat low (USDA 1974:16). Thus, although their crude protein content is quite high, it is a low quality protein. The protein composition of Papua New Guinea yams and in particular Abelam cultivars is still virtually unknown despite many well-intentioned research attempts over the years (S. George, Department of Primary Industry, pers. comm. 23 Nov. 1983).

It is possible however for "...for two proteins, each of which alone is unable to support growth...if eaten together...[to] be as effective as a high quality protein in meeting nutritional needs" (Guthrie 1974:72). This is known as protein complementarity and in many societies particular food combinations have evolved to maximise usable protein (eg., the "beans-maize-
squash complex" of the Americas). Many Gwelikum meals however, are single species ones, often for several meals in succession. It is reasonable to hypothesise that the probability of consuming poor quality protein from a single species meal (eg., yams) is higher than from a multiple species meal (eg., yams, greens, beans, coconut). Unfortunately, amino acid composition data and hence knowledge of optimal species compositions for protein complementarity are unknown for Abelam foods. More detailed analysis of the composition of Abelam foods, down to cultivar level, is needed.

5.2 Meal patterns: preparation, allocation, and consumption

Meal patterns

Most food in Gwelikum is eaten at predictable times of the day and by family groups of relatively consistent composition. Normally, a nuclear family eats as a unit, three times a day. The first meal is prepared soon after daybreak at the home hamlet hearth, the second between late morning and early afternoon either at the subsistence or coffee garden, and the third meal (which is the largest) at dusk back at the home hamlet. This very generalised pattern varies somewhat according to the following factors.

1. Time of Year

During the "lean period" (between February and June) the number of daily meals may be reduced from three to two or sometimes one.

2. Family Activities

Various activities influence the number of meals consumed in a day. Sundays are major days of Christian worship and for many people, long worshipping sessions may mean foregoing the second meal. Other activities altering the normal pattern are the work roster at the community school and forays to the Hayfield or Maprik markets.

3. Illness

If a young child is ill and needs treatment at the Aupik Aid Post (35 minutes walk each way plus waiting and treatment time) or Maprik Hospital
(2 hours walk each way plus a considerable wait) either the first or second meal may be omitted, because the child’s mother must invariably both cook meals and accompany the child for treatment. Sometimes a meal may be prepared before leaving but in these circumstances the second meal will probably be omitted. If the mother is too ill to work, the family may not eat in the normal manner (see Chapter 6 also).

4. Menstruation

Menstruating women are prohibited from preparing food for others but they may prepare their own food and that of a breastfed child. If the family head’s wife is menstruating and no other women in the family or hamlet are either competent or willing to prepare food for the family then whether that family eats normal meals will depend on the inclination of the family head. In some families such a situation causes no disruption as the head usually roasts some taro, bananas or yams. In other families however, the head may be prepared for his family to rely for food on the goodwill of friends or relatives during the course of the day.

5. Ceremonial and other occasions

Characteristically, ceremonial occasions involve large numbers of people and larger than normal intakes of food. Examples include: communal or group yam garden plantings, house constructions, death wakes, parties, ceremonies involving yam displays, female puberty rites, and pre-planting rites. Formerly, inter- and intra-village yam and pig exchange ceremonies, spirit house ceremonies and male initiations were major events in Gwelikum. On such occasions, men typically eat a number of dishes over a long period. Women tend to eat more than they normally do but less than the men. Children tend not to be specifically catered for in these circumstances but stay close to the adults (in particular, their fathers) in the hope of morsels. In addition to the different quantitative pattern of food consumption, there may also be a qualitative alteration. For example, if the event or ceremony involves the consumption of pig meat, although it is now normal for women
and children to be allocated a portion (previously, pig meat was forbidden), the bulk of the best meat is surreptitiously whisked away for hurried consumption by a select group of men. This is uncommon however, and represents one of the few occasions in which men, women and children have qualitatively different dietary patterns.

6. Family visitors

If a household head receives male visitors, they are served before any children or women. This may mean that the children and women do not eat at that meal, especially if the visitors are unexpected. Similarly, when the head visits other men, he usually eats food at their hearths and accordingly his intake pattern differs from that of his family.

7. Family dispersion

Not all families stay together all day every day. Frequently, some family members (especially men) leave the others for extended periods and accordingly their dietary intake patterns will differ from the others. Older children (> 7-8 years) commonly hunt or play in the forest. On such forays insects, lizards or perhaps birds are sometimes eaten in the seclusion of the forest but more commonly the children raid unattended food gardens for pawpaws or unattended plantings of peanuts, mangoes, oranges, guavas or other fruits in season. Thefts of fruit by children are so common that many owners of fruit trees complain that they never seem to be able to harvest any of their own produce! Because women in charge of infants and toddlers are constrained by subsistence work and child rearing, they have little freedom and accordingly, they and their charges are the least likely to vary from the standard pattern of meal consumption.

Preparation

Virtually all meals are cooked and are eaten soon after preparation. Foods eaten raw are mainly sweet fruits and sugar cane. Peanuts, if eaten at all, are invariably eaten raw. Once food is cooked it cannot usually be stored for more than a few hours or perhaps overnight (some baked sago
dishes may keep for a few days). Insects, rats, cats, dogs and pigs are avid competitors for meals not quickly eaten. Table 5-1 summarises the main cooking methods used in Gwelikum.

Morning meals are typically roasted, as are most meals prepared during the day (Table 5-2). If communal or other cooperative ventures such as garden planting or house building are in process, a boiled, processed meal with all the trimmings and/or soups is prepared, rather than roasted foods. Afternoon/evening meals are almost always a type of soup although processed, boiled staples and greens are also significant. This emphasis on soup meals at the end of the day is not surprising given that the people, from children through to the elderly, rarely drink any liquids during the day even if quite strenuous work is being undertaken. Water from immature coconuts is enthusiastically drunk but since over-exploitation of this resource later leads to a shortage of mature nuts, water from this source is not often utilised. Water from ground soaks is never taken unless a person is very thirsty - and then only in small quantities. A large soup meal at the end of the day thus serves as both food and drink.

Allocation

All aspects of day to day food preparation and allocation are under the control of the family head's wife or wives. The woman is the owner of all cooking equipment, coconut scrapers, bowls, cutlery, and condiments. Most men however, carry personal spoons in their bilums which is useful when offered a meal at another hearth. The exclusive use of a spoon also minimises risk of female pollution. The woman is responsible for meal planning and the procurement of all necessary greens and cooking water. Men may sometimes assist in the gathering of greens but only if it is incidental to or compatible with some other activity. Collecting firewood for cooking meals is also "women's work" as is all washing up. Coconuts are always scraped by young children or old people. It is believed that violation of this rule will mean deterioration in eyesight and premature ageing.
<table>
<thead>
<tr>
<th>COOKING METHOD</th>
<th>MAINLY USED WITH</th>
<th>RARELY USED WITH</th>
<th>COOKED AND/OR EATEN WITH</th>
<th>UTENSILS USED</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROASTING</td>
<td>Yam, maize, Saccharum edule, bananas, sago, breadfruit</td>
<td>Taro, sweet potato</td>
<td>Grated coconut with sago, nil with other staples</td>
<td>Cane tongs</td>
<td>Concentrates energy &amp; protein, drier texture, minimal preparation</td>
</tr>
<tr>
<td>&quot;SIMPLE&quot; BOILING</td>
<td>Yams, taro, bananas, sweet potato</td>
<td>Maize</td>
<td>Greens with sweet potato, nil with other staples</td>
<td>Saucepan</td>
<td>No change in energy/protein concentration, minimal preparation</td>
</tr>
<tr>
<td>&quot;PROCESSED&quot; BOILING</td>
<td>Yams, taro</td>
<td>Banana, sweet potato, taro tubercules</td>
<td>Greens, coconut milk</td>
<td>Saucepan</td>
<td>No change in energy/protein concentration, staples peeled and cut into pieces, very little liquid used</td>
</tr>
<tr>
<td>NON-STAPLE FOODS</td>
<td>All greens (garden and wild), beans, bamboo shoots</td>
<td>N/A</td>
<td>Coconut milk, tinned fish/meat</td>
<td>Saucepan or bamboo tubes</td>
<td>Very little or no liquid used, often accompanies rice or tuber based meals</td>
</tr>
<tr>
<td>SOUPS</td>
<td>1. Sago soup</td>
<td>N/A</td>
<td>Greens, esp. Gnetum gnemon</td>
<td>Saucepan</td>
<td>Very dilute, most basic os soups in terms of preparation</td>
</tr>
<tr>
<td></td>
<td>2. Sago jelly</td>
<td>N/A</td>
<td>Greens, esp Gnetum gnemon, fish, coconut milk</td>
<td>Saucepan</td>
<td>More concentrated than sago soup and more labour intensive</td>
</tr>
<tr>
<td></td>
<td>3. D. alata soups</td>
<td>N/A</td>
<td>Coconut</td>
<td>Saucepan</td>
<td>Rarely contains greens, labour intensive</td>
</tr>
<tr>
<td></td>
<td>4. D. esculenta soups</td>
<td>N/A</td>
<td>Coconut, Gnetum gnemon</td>
<td>Saucepan</td>
<td>Usually contains greens &amp; coconut labour intensive</td>
</tr>
<tr>
<td></td>
<td>5. Banana soups</td>
<td>Non-sugar type bananas</td>
<td>Coconut</td>
<td>Saucepan</td>
<td>Never contains greens, over-ripe sweet bananas used, labour</td>
</tr>
<tr>
<td></td>
<td>6. Other soups (sweet potato, pumpkin, wild yams, taro)</td>
<td>N/A</td>
<td>Coconut</td>
<td>Saucepan</td>
<td>Never contains greens, labour intensive</td>
</tr>
</tbody>
</table>

Table 5.1: Main cooking methods used in Gwelikum.
### Table 5-2: Food Types and Method of Preparation, by Meal Type, Gwelikum 2, December 1983 & March 1984.

<table>
<thead>
<tr>
<th>Month of Recall &amp; Time of Day</th>
<th>Most Common Staple Eaten</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>December 1983</strong></td>
<td></td>
</tr>
<tr>
<td><strong>M</strong></td>
<td>Yam (R) Bakery (R) Sago (R) Sago (R)</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>Nil</td>
</tr>
<tr>
<td><strong>E</strong></td>
<td>Sago (S)</td>
</tr>
</tbody>
</table>

| **March 1984**                 |                           |
| **M**                          | Banana (R) Sago (S) Yam (R) Sweet Pot. (B) |
| **N**                          | Banana (R) Sago (S) Breadfruit Yam (S) (R) Rice (B) |
| **E**                          | Sago (S) Sago (S) Banana (S) Breadfruit Taro (B) (R) Rice (B) |

**NOTE:** M = Morning Meal; N = Midday meal; E = Afternoon/Evening Meal

- R = Roasted foods
- B = Boiled Foods, all types
- S = Soups
The kitchen is a mobile one since aluminium saucepans are relatively expensive and people cannot afford the convenience of duplicate or even triplicate sets in different locations (eg., at garden houses or other frequently visited places). Thus, unless the woman is planning to roast all foods cooked away from the hamlet, she must carry her kitchen with her. Formerly, duplicate or triplicate sets of clay cooking pots were a necessity since they were not robust enough for frequent transporting about.

Food is allocated by the woman on the basis of both customary order of serving and her own judgement regarding quantities. When there are no visitors, the head is served first, his children, then his wife. If visitors are present, the sequence is the head, his male visitors, the wives and children of visitors, the head’s own children, and finally, the head’s wife.

If food is insufficient for the children and the woman, a second meal may need to be prepared. Depending on the inclination of the cook and immediate availability of foods, a simple, roasted meal may be prepared in lieu of the more elaborate type of meal previously foregone. Although the above protocol exists in both theory and practice, problems of food inadequacy for women and children arising from such a system of allocation are very rare. Some women have remarked to me (out of earshot of their husbands) that the protocol actually suits them better because in many meals, the so-called dregs are actually richer in some food items - the denser winged bean and cowpea seeds sink to the bottom of the saucepan, and these plus the greens are tastier in their puddle of coconut milk or water. Most men are not particularly keen observers of kitchen practice and tend to regard the leftovers as something less than worthy of them and therefore more appropriate for women. Perhaps women get the last laugh.

Customary rules during eating

Food is served in a variety of ways and once served, rules relating to movement near food and food sharing come into force. Meal time protocol varies from family to family and in some families all customary rules have
been abandoned. Of the extant rules, two are often observed (although not always, even within families!).

The first is that each person should eat from a designated bowl/spoon. Children should not eat from the bowls of their parents nor use their spoons. To do so means that ageing traits will be transferred more rapidly to the children and they will therefore lack strength and vigour as adults. Quite apart from this, there is the ever present belief that epilepsy, a greatly feared disorder, will be contracted from spoons/bowls. There are a number of epileptics in Gwelikum and surrounding villages. The important ability to climb trees, for example, will be especially impaired. This rule probably explains to some extent why adult men, after eating, place their private spoons in their bilums rather than offer the spoon to a nearby child who may be drinking soup from a bowl.

The second rule is that no person is permitted to step over the food of another. Since food is thought to be capable of both absorption of negative personal traits and female pollution and the transmission of these to others when eaten, the act of stepping over another person’s food will mean that any undesirable traits are absorbed by the food and subsequently transmitted to the consumer. A ceremonial yam grower fears being polluted by the actions of other family members - particularly if they disregard sex and food prohibitions.

Serving methods

Meals may be served either communally or as individual allocations. In the informal atmosphere of the family hearth, all children may be served together with one large allocation. A freshly cut banana or taro leaf is placed in a convenient location and food placed on top. This method is suited to boiled staples with or without greens. Soup dishes are not intentionally served as communal dishes although a bowl may be shared by a number of persons. Men are almost always served separately. Because of the fear of female pollution, particularly during the critical periods of ceremonial yam
cultivation, men eat aside from the main family. Formerly, at these critical
times, men were required to roast their own yams on their own fires and not
permitted to drink cold water. This practice has now been relaxed.

For individual servings, a number of plate and bowl types are used.
Large coconut shell bowls can contain up to one litre or one kilogram of
food. These bowls are used by adults and are reasonably popular as the shell
insulates the hands from scalding by the hot contents. Smaller coconut shell
bowls are intended for use by children but since they are less stable than
metal bowls (i.e., the base is not flat), they are not commonly used. Large
enamelled metal bowls are common and have a capacity of 1100 millilitres
but a serving usually holds no more than one litre or one kilogram in
practice. This bowl is analagous to the traditional coconut shell bowl.
Formerly, small clay bowls of similar capacity were also used. Small
enamelled metal bowls are commonly used by children and hold about 500
millilitres or 500 grams of food. In the absence of any bowls or plates, a
non-soup meal will be offered in a freshly cut leaf.

5.3 General patterns of dietary intake

The following description divides Gwelikum foods into two categories -
staples and greens. The former includes all of the common subsistence foods
which provide the bulk of carbohydrate and hence energy needs and also
includes store bought staples such as rice. The greens category includes all
leafy greens, relatively low in energy but high in protein, and also included
are various animal proteins (including store bought items) and miscellaneous
non-staple items. The adoption of this dichotomy for descriptive purposes is
consistent with the approach used by Ross (1984) in his analysis of a Wosera
Abelam village. The separation of staples from greens is consistent also with
Abelam food taxonomy, although animal proteins are separated from greens
(see Chapter 3). Coconut consumption is considered separately.

Overview
Between November 1983 and September 1984, the Gwelikum diet varied considerably. The main variations related to the number of meals eaten with greens (Figure 5-2); the number of meals eaten with coconut (Figure 5-3); the number of species of staples and greens eaten per meal (Figure 5-4); and the relative importance of different species of staples and greens consumed.

Greens consumption declined steeply from November 1983 to December 1983, but rapidly peaked in February 1984 (Figure 5-2). The significance of this change in relation to environmental events is discussed in Chapter 8. Significant is the large proportion of meals consumed as "staples only".

Although coconut palms are ubiquitous and coconut milk and grating preparation is often seen, the actual proportion of meals eaten with coconut in any form was very low (Figure 5-3). Villagers stated that the palms were not bearing well and this was attributed to an extended drought for most of 1983. The rapidity of mature coconut sales at the Maprik and Hayfield markets supported this view. There were temporal fluctuations in the proportions, with slight peaks in November 1983 and June 1984. There were also temporal fluctuations in the diversity of species eaten (both staples and greens) (Figure 5-4).

Variation was much greater with regard to consumption of greens - February 1984 was once again a peak month. Staples were eaten relatively constantly over time; there were few occasions when a meal contained more than one species. If the data in Figure 5-4 are considered in terms of frequency classes a more detailed image of greens diversity emerges (Figure 5-5).

The period from December 1983 to February 1984 was one of slightly higher greens consumption diversity (with approximately ten percent of meals combining three species of greens), but the usual consumption pattern was for one or two species to be eaten in combination.

Patterns of staples consumption

There were marked seasonal fluctuations in the species of staples eaten
Figure 5-2: Meals Eaten Without Greens

Meals consumed as staples only
Meals consumed with greens and/or animal proteins
Figure 5-3: Coconut Usage With Meals

- Meals eaten without coconut milk or gratings
- Meals eaten with coconut products
Figure 5-4: Mean Number of Species Eaten Per Meal, all meals included.
Figure 5-5: Species Diversity of Greens Eaten - Frequency of Species Per Meal.
(Figure 5-6), and these variations are very closely related to the annual garden cycles (Chapter 8).

The consumption of yams is perhaps the most variable, with over 50 percent of meals in November 1983, yet only ten percent of meals in March 1984 based on this staple. During the period when yams are scarce (January-June), sago assumes principal status, although bananas are very important also. When yams were scarcest in March 1984, a number of other staples assumed greater importance - particularly rice, taro, and breadfruit seeds. At that time rice was important as a food payment for garden planting work groups. Sweet potato was consistently eaten all year. During May and June, maize became significant as a secondary staple, and reflected the first main yields from gardens planted between January and March. Between June and August, the first yams and taro tubers were harvested (by the women before the men harvest the yams), and increased numbers of meals comprised these staples. Rice consumption was at its highest during July - August, and reflected increased cash derived from coffee production.

Apart from these various staples, only a very small number of other food types were eaten. My assumption on arrival was that cassava would be an important secondary staple. Cassava plants abound - in old gardens, near hamlets and along roadsides. However, cassava was not commonly eaten. Although certain cassava dishes (such as grated cassava and coconut wrapped in banana leaves and steamed in a saucepan) were very popular, they require lengthy preparation. Most people also suspect that cassava is not a "good" food - it has no gris (ie., no substance or body). Much of the cassava was simply uprooted and the tubers boiled, then fed to the few village pigs. Other items occasionally eaten included peanuts (raw), pumpkin fruit, and wild yams (*D. pentaphylla*) in season¹.

**Patterns of greens/animal origin foods consumption**

¹* Dioscorea pentaphylla *grows naturally in forest regrowth. When a new garden is prepared, any *D. pentaphylla* plants found growing are protected from fire and nurtured in the same manner as cultivated *D. esculenta*.
Figure 5-6: Frequency of Consumption of Different Staples (Percent)
The frequency and importance of various greens changes markedly over time (Figures 5-7 & 5-8). *Gnetum gnemon* was clearly the most commonly eaten leafy green. Although an evergreen tree species, it does not continually yield new growth suitable for harvesting. This species is also sensitive to dry periods which quickly check new growth. Pumpkin tips and *Abelmoschus manihot* were also significant over the whole year. Pumpkin plants are scattered around most hamlets, in old gardens and verging many bush tracks and coffee gardens, and are very often self-seeding (as many fruits are unharvested) thus ensuring a continuous supply of tips. *Abelmoschus manihot* is planted in new gardens every year but since it is a vigorous perennial, it too is usually available all year. February 1984 stands out as a time of both overall more frequent greens consumption and higher diversity of species eaten. During this month *Saccharum edule* inflorescences from canes planted in February 1983 were harvested and eaten. *Amaranthus sp* began to appear in some of the gardens planted in November - December 1983, as did the various beans. *Amaranthus sp* and beans did not become prominent until April - June. Thus, *Amaranthus sp*, beans and maize were the first crops harvested from the new gardens.

Tinned fish was eaten in all months but two periods stand out (as with rice). First, in February - March 1984, which may reflect the types of dishes prepared to feed garden planting work groups; and second, the "cash season" of July - August 1984. During July 1984, when young men hunted bandicoots\(^2\), a discernible contribution of "other foods" appears. The sudden surge of pumpkin tips consumption during June 1984 probably reflects the rapid decline in *Amaranthus sp* availability. *Amaranthus sp* is a short-lived species which is only planted once in each new garden. Thus, pumpkin tips substituted for *Amaranthus sp* while *Gnetum gnemon* availability was still low during the drier months.

\(^2\)During the dry season, papery termite nests are used as a bandicoot bait. The baits are placed on known bandicoot trails and on moonless nights, the hunters wait. When a bandicoot alerts the hunter, he shines his battery powered torch then quickly kills the bandicoot with a three pronged spear. This practice is new and replaces the traditional use of woven snare traps.
Figure 5-7: Frequency of Consumption of Various Greens and Foods of Animal Origin - All Meals Eaten

- Meals consumed without greens and/or animal proteins
- Tinned fish
- Beans - all varieties
- Amaranthus sp.
- Saccharum edule
- Abelsmoschus manihot
- Pumpkin leaves/tips
- Gnetum gnemon
- Other greens/animal proteins (includes: bamboo shoots, onions, fungi, tinned meat, insects, pig and bandicoot meat)
Figure 5-8: Frequency of Consumption Of Various Greens and Foods of Animal Origin - “Staples Only” Meals Excluded.
General sources of energy and protein

The overwhelming proportion of energy intake is provided by staple tubers. Greens and animal foods supply only a very small proportion of dietary energy. A similar, but more muted pattern occurs for protein, and although staples are the main source, there are more seasonal fluctuations in the relative contributions made by staples and greens. February 1984, for example, was a month of high protein contribution from greens (Figure 5-9).

Seasonal variations in energy and protein intakes

There is a strong seasonal pattern in both energy and protein intake levels, with initially high levels in November 1983, a steady decline until May 1984 (the lowest levels) and a recovery in July 1984 (Figures 5-10 & 5-11). During the “lean period”, mean dish sizes offered to under fives were significantly smaller (374 gms) than during the “period of abundance” (589 grams) (Chapter 2). Adult dish sizes remained relatively constant however (except soups which were larger in the “lean period”), and suggests that quantitative dietary adjustments because of food “scarcity” are felt more by children than adults. Significantly, adult body weights did not alter between February 1984 and July 1984. Although no data on breastmilk supply or quality were recorded, the breastfed toddler was often seen to miss normal meals and to some extent this is reflected in more “no food eaten” responses in the dietary recall surveys. This, in addition to a possible qualitative difference in foods given to breastfed children leads to the following analysis which considers the under fives as two sub-groups: breastfed children receiving supplementary foods, and weaned children (Table 5-3). Exclusively breastfed children (ie., during fieldwork, all infants up to 8 months of age) are omitted.

Breastfed under fives - energy and protein intakes

The data presented in Tables 5-4, 5-5, 5-6, and 5-7 are estimates only

---

1It is possible however, that this is because energy and protein intakes had already declined by February 1984 - both sample periods were thus low intake periods.
Figure 5-9: Proportions of Total Energy and Protein Intake Derived from Staples, Under Fives, Gwelikum 2.
Figure 5-10: Estimated Energy (Kj) intakes, under Fives, Gwelikum 2.
Figure 5-11: Estimated Protein (Gms) intakes, under fives, Gwelikum 2
Table 5-3: Basic Details of the Breastfed and Weaned Sub-Groups of Under Fives, Gwelikum 2.

<table>
<thead>
<tr>
<th>Category of under fives</th>
<th>Total</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean Wgt (SD)</td>
<td>N</td>
</tr>
<tr>
<td>Breastfed *</td>
<td>15</td>
<td>8.55 (1.41)</td>
<td>7</td>
</tr>
<tr>
<td>Weaned **</td>
<td>25</td>
<td>13.86 (3.2)</td>
<td>12</td>
</tr>
</tbody>
</table>

* Age range = 8-24 months
** Age range = 25-60 months

(see Chapter 2). The data are calculated by applying energy and protein values from "standardised servings" to information from dietary recall. The data do not allow for many of the realities of dietary intake behaviour observed in under fives (see next section), nor do they allow for variations in amounts consumed according to age. Thus, the estimates in respect of breastfed under fives are probably slightly over-estimated and with weaned under fives under-estimated.

In general, estimated energy intake requirements were met in most months (Table 5-4), but protein requirements were not met for all months for all children in the group except in November 1983 (Table 5-5). In the other months, while some children attained FAO/WHO (1973) "safe" intake levels, others did not. These estimates do not take account of the energy and protein contributions by breastmilk, so although they are under-estimated in one sense, they are over-estimated for reasons stated above. The general pattern however, is that breastfed under fives do not consume adequate protein.

Weaned under fives - energy and protein intakes

In no months were energy requirements fully met but the intake was lowest in May and June 1984 (Table 5-6). As with the breastfed group, the "standard portions" used to calculate intakes may not reflect the reality of
Table 5-4: Mean Energy Intake (Kj) and Percentage of Requirements Met, Breastfed Under Fives, Gwelikum 2.

<table>
<thead>
<tr>
<th>Month</th>
<th>N</th>
<th>Mean Intake Kj (SD)</th>
<th>Percentage of Requirements Met *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>Nov 83</td>
<td>12</td>
<td>4146 (1442)</td>
<td>113 (39)</td>
</tr>
<tr>
<td>Dec 83</td>
<td>11</td>
<td>3805 (2013)</td>
<td>104 (55)</td>
</tr>
<tr>
<td>Feb 84</td>
<td>9</td>
<td>3925 (1324)</td>
<td>107 (36)</td>
</tr>
<tr>
<td>Mar 84</td>
<td>10</td>
<td>3843 (1504)</td>
<td>105 (41)</td>
</tr>
<tr>
<td>May 84</td>
<td>10</td>
<td>3002 (1802)</td>
<td>82 (49)</td>
</tr>
<tr>
<td>June 84</td>
<td>11</td>
<td>3580 (1802)</td>
<td>98 (49)</td>
</tr>
<tr>
<td>July 84</td>
<td>11</td>
<td>3717 (2081)</td>
<td>102 (57)</td>
</tr>
<tr>
<td>Sep 84</td>
<td>10</td>
<td>3599 (1992)</td>
<td>99 (55)</td>
</tr>
</tbody>
</table>

* FAO/WHO (1973) recommendations adopted (424.5 kj/kg/day).

Values in parentheses represent the percentage of requirements "covered" by the Standard Deviation.
<table>
<thead>
<tr>
<th>Month of Survey</th>
<th>N</th>
<th>Mean Intake Grams (SD)</th>
<th>Percentage of Requirements Met • Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov 83</td>
<td>12</td>
<td>22.7 (9.2)</td>
<td>98-133 (39-54)</td>
<td>99-135 (40-54)</td>
</tr>
<tr>
<td>Dec 84</td>
<td>11</td>
<td>15.6 (9.1)</td>
<td>67-91 (39-53)</td>
<td>68-93 (40-54)</td>
</tr>
<tr>
<td>Feb 84</td>
<td>9</td>
<td>18.9 (6.3)</td>
<td>82-111 (27-37)</td>
<td>83-113 (27-37)</td>
</tr>
<tr>
<td>Mar 10</td>
<td>19.4 (10.4)</td>
<td>83-114 (45-61)</td>
<td>84-115 (45-62)</td>
<td></td>
</tr>
<tr>
<td>May 10</td>
<td>10</td>
<td>13.4 (7.7)</td>
<td>58-78 (33-45)</td>
<td>58-79 (33-45)</td>
</tr>
<tr>
<td>June 11</td>
<td>14.4 (8.9)</td>
<td>62-85 (38-52)</td>
<td>63-86 (39-53)</td>
<td></td>
</tr>
<tr>
<td>July 11</td>
<td>17.2 (10.9)</td>
<td>74-101 (47-64)</td>
<td>75-102 (47-64)</td>
<td></td>
</tr>
<tr>
<td>Sep 84</td>
<td>10</td>
<td>19.4 (10.2)</td>
<td>83-113 (44-60)</td>
<td>84-115 (44-61)</td>
</tr>
</tbody>
</table>

* "Safe level" protein requirement is calculated on the basis of a range of 2.7g/kg/day to 1.983g/kg/day at 60 percent of egg/milk protein. The range exists because of the age range of the Gwelikum group (8-24 months approximately). Protein requirements vary with age. Values per FAO/WHO (1973). The values in parentheses represent the range in the percentage of requirements "covered" by the standard deviation.
consumption. The main source of error or variation not included in the "standard portions" is the practice of second servings at meal times. A commensurate increase in food intake capacity occurs with increasing body growth. Some children may eat a second smaller serving some time after the first serving, but it is highly variable between children and indeed for the same child, so establishing an "addition factor" is very difficult and has not been attempted.

Sub-optimal protein intake levels are suggested for most children for most months (Table 5-7). As with energy intake levels, the values in Table 5-7 are probably conservative and could be adjusted upwards, but the "addition factor" to be applied has not been estimated. Notwithstanding any notional upwards adjustment, protein intake levels are very low, and this is consistent with the long-term growth outcome of children and adults - that is, mild stunting.

In summary, the breastfed group received a higher percentage of necessary energy requirements than protein requirements, and this group received more energy and protein than the weaned group. Energy and protein intake levels, for both groups, declined rapidly after March 1984 and were at their lowest in May 1984. A major recovery in intake levels occurred in July 1984. Without a longer time series of data, it is difficult to definitely attribute this pattern to regular seasonal phenomena, although it is reasonable to conclude that it is.

**Seasonal intake patterns - some comparisons**

My estimates of dietary intake at two periods ("period of abundance" and "lean period") are compared for similar periods with the measured Wosera Abelam data of Whiteman (1965) and Ross (1984). Sample sizes, ages, and weights (as far as they are known) are shown in Table 5-8 and the comparative dietary intake data in Table 5-9, and Figures 5-12 and 5-13.

Although the methodologies differ, the general nutritional pattern shown by the three studies is similar. For both breastfed and weaned under fives,
Table 5-6: Mean Energy Intake (Kj) and Percentage of Requirements Met, Weaned Under Fives, Gwelikum 2.

<table>
<thead>
<tr>
<th>Month of Survey</th>
<th>N</th>
<th>Mean Intake Kj (SD)</th>
<th>Percentage of Requirements Met</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov 83</td>
<td>20</td>
<td>4971 (1266)</td>
<td>90 (23)</td>
<td>86 (22)</td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td>20</td>
<td>4993 (1606)</td>
<td>90 (29)</td>
<td>87 (28)</td>
<td></td>
</tr>
<tr>
<td>Feb 84</td>
<td>23</td>
<td>4117 (1431)</td>
<td>74 (26)</td>
<td>72 (25)</td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td>25</td>
<td>3990 (1198)</td>
<td>72 (22)</td>
<td>69 (21)</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>24</td>
<td>3376 (1177)</td>
<td>61 (21)</td>
<td>59 (20)</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>25</td>
<td>3672 (854)</td>
<td>66 (15)</td>
<td>64 (15)</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>24</td>
<td>5048 (1469)</td>
<td>91 (27)</td>
<td>88 (26)</td>
<td></td>
</tr>
<tr>
<td>Sep 84</td>
<td>25</td>
<td>3883 (1539)</td>
<td>70 (28)</td>
<td>67 (27)</td>
<td></td>
</tr>
</tbody>
</table>

* FAO/WHO (1973) recommendations. 407.75 Kj/kg/day adopted.

Values in parentheses represent the percentage of requirements "covered" by the standard deviation.
Table 5-7: Mean Protein Intake (Gms) and Percentage of Requirements Met, Weaned Under Fives, Gwelikum 2.

<table>
<thead>
<tr>
<th>Month of Survey</th>
<th>N</th>
<th>Mean Intake (SD)</th>
<th>Percentage of Requirements Met Males</th>
<th>Percentage of Requirements Met Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov 83</td>
<td>20</td>
<td>25.0 (7.8)</td>
<td>93-110 (29-34)</td>
<td>89-105 (28-33)</td>
</tr>
<tr>
<td>Dec</td>
<td>20</td>
<td>25.2 (10.7)</td>
<td>94-110 (40-47)</td>
<td>90-106 (38-45)</td>
</tr>
<tr>
<td>Feb 84</td>
<td>23</td>
<td>18.9 (7.7)</td>
<td>70-83 (29-34)</td>
<td>68-80 (28-32)</td>
</tr>
<tr>
<td>Mar</td>
<td>25</td>
<td>21.2 (10.2)</td>
<td>79-93 (38-45)</td>
<td>76-89 (37-43)</td>
</tr>
<tr>
<td>May</td>
<td>24</td>
<td>15.6 (6.6)</td>
<td>58-68 (25-29)</td>
<td>56-66 (24-28)</td>
</tr>
<tr>
<td>June</td>
<td>25</td>
<td>17.4 (9.4)</td>
<td>65-76 (35-41)</td>
<td>62-73 (34-40)</td>
</tr>
<tr>
<td>July</td>
<td>24</td>
<td>24.4 (8.9)</td>
<td>91-107 (33-39)</td>
<td>87-103 (32-38)</td>
</tr>
<tr>
<td>Sep 84</td>
<td>25</td>
<td>19.6 (8.1)</td>
<td>73-86 (30-35)</td>
<td>70-83 (29-34)</td>
</tr>
</tbody>
</table>

*"Safe level" protein requirement is calculated on the basis of a range of 1.983 g/kg/day to 1.683 g/kg/day at 60 percent of egg/milk protein. These values per FAO/WHO (1973). The values in parentheses represent the range in the percentage of requirements "covered" by the standard deviation.
energy and protein intakes are low in the traditional "lean period" and higher in the "period of abundance". My estimates further suggest that energy and protein intakes are more variable in the "period of abundance" than during the "lean period" for both breastfed and weaned children.

Although the Abelam cultural meaning of the "lean period" does not refer to a quantitative reduction in dietary intake, the reliance on more dilute meals (eg., sago soups) during this period reflects in a qualitative reduction in intake. In addition, under fives are fed slightly smaller meals during the "lean period". Nutritionally, these qualitative and quantitative reductions are measured by a fall in energy and protein intake.

In the previous chapter, it was noted that March 1984 was the best month for the W/A and W/L growth indices. Explaining the growth fluctuations for such a short time series is difficult but February 1984, although a month of declining general energy and protein intakes, had the highest frequency of meals eaten with greens; the highest greens (ie., species) diversity; relatively consistent consumption of tinned fish and rice (associated with peak garden planting); and fewer malaria treatment days (see Chapter 6).

5.4 Dietary intake problems with the under fives

It is clear that the inherent bulk-density characteristics and the seasonal variations in the bulk-densities of various foods are the underlying factors behind the general, sub-optimal protein and energy intakes of under fives at various times of the year. However, there are a number of other factors (especially applicable to the under fives) factors which, when added to the inherent food problems faced, result in a suite of obstacles to achieving satisfactory dietary intakes. The toddler group experiences the most severe medium-term wasting, and is the most affected by these aggregate factors.

The very narrow range of species eaten in most meals increases the probability of lower quality (ie., less available or usable) protein intake. In
### Table 5-8: Summary of Data Used in Comparative Analysis

1. Breastfed Group
   (a) Females

<table>
<thead>
<tr>
<th>Researcher</th>
<th>N</th>
<th>Age Range</th>
<th>Mean age (mths)</th>
<th>Mean Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whiteman (1965)</td>
<td>N/A</td>
<td>13-18 Mths</td>
<td>N/A</td>
<td>6.0</td>
</tr>
<tr>
<td>Ross (1984)</td>
<td>1</td>
<td>16 Mths</td>
<td>16</td>
<td>8.1</td>
</tr>
<tr>
<td>This Study</td>
<td>8</td>
<td>11-30 Mths</td>
<td>21</td>
<td>8.51</td>
</tr>
</tbody>
</table>

(b) Males

<table>
<thead>
<tr>
<th>Researcher</th>
<th>N</th>
<th>Age Range</th>
<th>Mean Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whiteman (1965)</td>
<td>N/A</td>
<td>3-5 Years</td>
<td>10.0</td>
</tr>
<tr>
<td>Ross (1984)</td>
<td>2</td>
<td>16-22 Mths</td>
<td>19</td>
</tr>
<tr>
<td>This Study</td>
<td>7</td>
<td>13-36 Mths</td>
<td>21</td>
</tr>
</tbody>
</table>

2. Weaned Group
   (a) Females

<table>
<thead>
<tr>
<th>Researcher</th>
<th>N</th>
<th>Age Range</th>
<th>Mean Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whiteman (1965)</td>
<td>N/A</td>
<td>3-5 Years</td>
<td>11.5</td>
</tr>
<tr>
<td>Ross (1984)</td>
<td>3</td>
<td>2-4 Years</td>
<td>36</td>
</tr>
<tr>
<td>This Study</td>
<td>9</td>
<td>2-5 Years</td>
<td>39</td>
</tr>
</tbody>
</table>

(b) Males

<table>
<thead>
<tr>
<th>Researcher</th>
<th>N</th>
<th>Age Range</th>
<th>Mean Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whiteman (1965)</td>
<td>N/A</td>
<td>3-5 Years</td>
<td>9.3</td>
</tr>
<tr>
<td>Ross (1984)</td>
<td>6</td>
<td>2-4 Years</td>
<td>44</td>
</tr>
<tr>
<td>This Study</td>
<td>10</td>
<td>2-5 Years</td>
<td>44</td>
</tr>
</tbody>
</table>
Table 5-9: A Comparison of Three Abelam Nutrient Intake Studies - Mean Energy (kj) & Protein (gms) Plus SD or Range Where Known.

<table>
<thead>
<tr>
<th>Researcher</th>
<th>Season of Abundance (1)</th>
<th>Lean Period (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Energy</td>
<td>Protein</td>
</tr>
<tr>
<td>(a) Breastfed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whiteman (3)</td>
<td>1105</td>
<td>4.4</td>
</tr>
<tr>
<td>(1965) (4)</td>
<td>3127</td>
<td>14.8</td>
</tr>
<tr>
<td>Ross (1984)</td>
<td>632-1385</td>
<td>2.9-17.1</td>
</tr>
<tr>
<td>This Study</td>
<td>3717(2081)</td>
<td>17.23(10.87)</td>
</tr>
<tr>
<td>(b) Weaned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whiteman (1965)</td>
<td>3106-3327</td>
<td>14.2-20.7</td>
</tr>
<tr>
<td>Ross (1984)</td>
<td>4161(417)</td>
<td>24.57(5.14)</td>
</tr>
<tr>
<td>This Study</td>
<td>5048(1469)</td>
<td>24.35(8.95)</td>
</tr>
</tbody>
</table>

Notes:
(1) Season of abundance: (2) Lean period:
This study July This study May

(3) Females
(4) Males
Figure 5-12: Comparative Abelam Energy & Protein Intakes - Breastfed Under Fives.

NON-WEANED UNDER FIVES ENERGY INTAKES (kj)

Period of abundance

Lean period

NON-WEANED UNDER FIVES PROTEIN INTAKES (gms)

Period of abundance

Lean period

Whiteman (1965)  Ross (1984)  This Study  * Range unknown
Figure 5-13: Comparative Abelam Energy & Protein Intakes - Weaned Under Fives.

WEANED UNDER FIVES ENERGY INTAKES (kJ)

<table>
<thead>
<tr>
<th>Period of abundance</th>
<th>Lean period</th>
</tr>
</thead>
<tbody>
<tr>
<td>6500-1</td>
<td></td>
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<tr>
<td>6000-</td>
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<td>5500-</td>
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<td>5000-</td>
<td></td>
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<td>4500-</td>
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<td>4000-</td>
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<td></td>
</tr>
<tr>
<td>1500-</td>
<td></td>
</tr>
<tr>
<td>1000-</td>
<td></td>
</tr>
</tbody>
</table>

WEANED UNDER FIVES PROTEIN INTAKES (gms)

<table>
<thead>
<tr>
<th>Period of abundance</th>
<th>Lean period</th>
</tr>
</thead>
<tbody>
<tr>
<td>35.0</td>
<td></td>
</tr>
<tr>
<td>32.5</td>
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</tr>
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<td>30.0</td>
<td></td>
</tr>
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<td>27.5</td>
<td></td>
</tr>
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<td>25.0</td>
<td></td>
</tr>
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<td>22.5</td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td></td>
</tr>
<tr>
<td>17.5</td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td></td>
</tr>
<tr>
<td>12.5</td>
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</tr>
<tr>
<td>10.0</td>
<td></td>
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<tr>
<td>7.5</td>
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<td>5.0</td>
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</table>
younger children, because of the bulk-density problem, such a risk is of greater negative consequence than in older children and adults who are able to overcome the bulk-density problem. The bewildering inventory of species, cultivars, meal combinations, and cooking methods masks the reality of daily nutritional life - a lot eaten of very few species is the reality. That the reality and the inventory or range of possibilities are confused by some writers surprises me. Obrist (in press) for example, concluded from a literature review that Sepik (and Abelam) diets were seemingly “extremely diverse” and found Oomen’s (1971:3) observations that in reality, only “...few varieties of plants are present in the daily diet in significant quantities” as “puzzling”. My Gwelikum data support Oomen’s observations. That such horticultural and culinary diversity should reduce to a relatively monotonous dietary regimen is the really puzzling feature.

The culinary skills of cooks vary widely, and this affects toddler feeding behaviour. Some cooks do not bother to remove stalks from leaves (eg., *Gnetum gnemon* stalks can be quite fibrous and even woody; *Abelmoschus manihot* stalks can be large and unwieldy); sometimes large, older *Abelmoschus* leaves are not excluded, much to the annoyance of some people who do not like the slimy texture; mature *Gnetum gnemon* leaves may be bitter and are unpopular; pumpkin tips are sometimes too long and are difficult to manipulate with a spoon when eating. Some cooks are so lax in these seemingly minor matters that they have become notorious. Others are much more careful and are also widely acknowledged as good cooks. I have not encountered any literature references to such variations in skill and care between cooks in PNG societies - possibly because it is assumed that little skill is required to prepare and cook the normal range of village meals. The differences between cooks are real and are considered important by Gwelikum people. I am certain that particular foods, when prepared carefully, are more palatable than the same foods prepared carelessly and that this is of importance in the nutrition of younger children. For example, a young child
of poor dexterity will ingest fewer leafy greens if they are unwieldy, tough, fibrous, bitter, or slimy, than if the meal is thoughtfully prepared. As with the preparation of greens, some cooks prepare very appetising yam soups, others not. Some cooks do not exclude the fibrous end of the yam and this sometimes ends up in the bowl - these fibres defy the cooking process. Some varieties of yam are less suited to soup and if used, leave many fibres and/or impart a strong flavour. Sometimes greens are not prepared carefully or are omitted altogether. Others do not bother with coconut (or do not have a mature coconut). Some people dislike grated coconut in soups and never include it. What this means in terms of protein complementarity is open to speculation. This type of yam soup, to be most enjoyable (and nutritious?), should include all three ingredients - yams, *Gnetum gnemon* and coconut.

Ease of handling a meal or dish varies according to the age of the person and the type of meal eaten. Toddlers have considerable difficulty with the large spoons commonly used, and usually resort to eating with their fingers. Nothing smaller than a dessert spoon was seen in the village. No special provisions are made for children's cutlery. Adults do not often assist their young children, or if they do, only for a short time. A poorly prepared soup meal for example, with large leaves or woody stems, will present extra problems for the child who will tend to avoid them. Thus, a poor sago soup will mean more sago and less greens will be eaten. Sago soup and jelly provide real challenges to even experienced spoon users - young children have considerable difficulty with these dishes. Traditional spoons made from coconut shells or bivalve mussels seem more suited to sago dishes but they are rarely used now. Young children cope very well with roasted foods, especially yams and bananas - they are easily held and are not messy. One disadvantage, however, is their dryness which requires more chewing.

Older children and adults prefer spoons for eating most meals other than roasted or simple boiled tubers. If spoons are unavailable, soups are drunk directly from the bowl. This method works reasonably well if the
greens have been properly prepared. Sago soup/jelly dishes present special difficulties because of their viscosity. Younger children attempting to emulate their parents in similar circumstances make hard work of the task with much of the sago ending up on the skin or on the ground.

No special techniques are used to prepare food for young children. Formerly, women (mothers, grandmothers, sisters or other custodians) premasticated certain foods (yams, bananas, greens) and either spat small portions into the child's mouth or used the fingers to place food into the mouth. This form of food preparation has now completely disappeared, possibly because of the efforts of early medical patrols and MCH Clinics which considered that the practice assisted in the transmission of tuberculosis. I saw one very old woman premasticating food for a young dog but after further investigation I established that the practice is now generally considered distasteful. Indeed, most young women know nothing of it.

Most children are introduced to solids at about 8 months of age, but this is clearly too late as growth begins to falter at about 6 months. Thereafter, supplementary foods are not provided on a continuous basis - indeed it is typically a punctuated pattern. Weaning behaviour is discussed in more detail in Chapter 7, but the late start to supplementary foods and the punctuated intake pattern are clearly important in understanding the problems faced by toddlers.

Infants and toddlers are denied certain foods which are classed as "strong". No special meaning is given to "strong" (unlike "hot" and "cold") - it refers to those foods which require more chewing than the usual items in the diet. "Strong" foods include animal flesh, mature coconut flesh, breadfruit seeds, Gnetum gnemon leaves, and certain of the coarser and firmer yam and banana varieties. The age at which these foods are introduced varies widely but all mothers claim that the absolute minimum age is when the first four deciduous teeth have emerged (for the "less strong" foods such as yams and bananas). The "strongest" foods are withheld until most deciduous teeth have emerged.
Some serving methods and the customary rules governing food consumption disadvantage infants and toddlers. Communal serving allows for both unmanaged selective eating (e.g., leaving the protein-rich leaves), and older siblings out-competing the younger children. The belief that foods should not be fed to infants and toddlers from the parental spoon and bowl means that many children are left to fend for themselves. Many have poor manual dexterity and selectively eat (and spill) many foods. The need to avoid stepping over foods is less nutritionally important, but encourages more dispersed sitting positions at meal times, thus creating a distance barrier between adults and children.

Other rules in principle disadvantage children, but in practice do not appear important. Although food allocation protocol places children and women after men and visitors, I rarely saw individuals failing to get their normal allocation because of this rule. Indeed, there is a surplus following allocation of portions in most meals. The surplus is either eaten later, offered to neighbours, or given to animals - it is never discarded. Similarly, at ceremonial occasions, although men appear to nutritionally benefit at the expense of others, young children sufficiently pester their fathers for morsels that they too invariably eat more food over a longer period than in normal circumstances.

The following case studies (from field notes) illustrate some of the realities of daily food consumption and contain examples of many of the aforementioned dietary problems faced by younger children. In particular, a number of phenomena are illustrated: communal serving; selective consumption; disruption of dietary routine through illness and menstruation; food sharing; spillage; and the secret consumption of food. The examples are typical of the regular, ongoing nature of Gwelikum dietary life. They also include a number of episodic, short-term factors influencing dietary intake which are discussed in more detail in the next section.

• Example 1. This meal was prepared in the early afternoon of a
day spent by family A processing cherry coffee. Four species of
 tuber were peeled and cut (Yams of *D. alata* & *D. esculenta*,
 *Colocasia* taro and *Xanthosoma* taro) and boiled with
 *Abelmoschus manihot* leaves. Present for this meal was the family
 head, his wife, a three year old weaned girl and a three month
 old infant. A middle aged couple was also processing coffee at the
 same location. As the meal was cooking, the family head roasted
 two *Xanthosoma* taro tubers for himself and his daughter. When
 the main meal was ready, two communal piles were allocated, one
 for the family and the other for the couple, and placed on freshly
 cut banana leaves. The couple had other commitments so they
took their share with them for later consumption. The family
began eating immediately. The young girl ate more than half of
the *Abelmoschus manihot* leaves before being curtailed by her
parents. This child was unusual amongst Gwelikum under fives in
preferring greens to staples. She always ate any greens first
(particularly *Abelmoschus manihot*) whereas most other children
regarded greens as unpalatable food, and frequently left them.

- **Example 2.** This meal was prepared at the home hamlet of
 family B soon after daybreak and comprised peeled and cut yams,
 *Abelmoschus manihot* and cowpea seeds (*Vigna sesquipedalis*). A
 number of people contributed to its preparation and participated
in its consumption. The group included the family head, his wife
and 22 months old breastfed son, his parents and a male
neighbour. The neighbour's wife did not eat that morning because
their child (also 22 months old) was ill with malaria and the two
had departed early for the Aupik Aid Post. The head's mother
peeled the yams (a similar custom to that applying to coconut
scraping); the wife prepared the fire, collected the cooking water,
sliced the yams and *Abelmoschus sp*; the head removed the
cowpea seeds ("beans") from the pods. The head also prepared a
dry sago/beans meal cooked in a bamboo tube for later private
consumption. He planned to work with some other men at a coffee
garden. The cooking and allocation was done by the wife. Each
person was given a separate bowl of yams, *Abelmoschus sp* and
beans, although the young boy was given a slightly higher
proportion of beans than the others. This boy had a particular
liking for beans of all kinds. During the meal, the young boy,
having finished his beans, went over to his grandfather, indicating
that he wanted more. The grandfather gave him all of his beans,
most of his original serving. The young boy, after completing his
second helping of beans, complained that he was "full-up" and
gave his mostly uneaten yam to his mother.

- **Example 3.** Examples 3, 4 and 5 relate to the same family
 (family C) but in different circumstances. One evening meal
consisted of two dishes: sago soup and banana soup. Although the
family usually comprises eight consumers (adults and children) the
description is restricted, for brevity, to the head, his wife and
their 23 months old breastfed son. The young boy was given a
small dish of sago soup and a dessert spoon. He had started using
a spoon only recently and was clearly a novice. After a short time
he gave up and started using a freshwater mussel shell instead.
These shells are very very common in the kitchen as they are used
as coconut scrapers. His father helped by scooping up the soup
with the shell but the child kept spilling the contents. After a few mouthfuls he gave up and went to his mother and started breastfeeding. An older child finished the meal. In between brief breastfeeding sessions, the boy helped himself to some of his mother's banana soup. After a short time he fell asleep and that concluded his eating for the day.

- **Example 4.** The events described here occurred over a two day period approximately one month after those described in Example 3. The male head and some of his children were sitting about quietly adjacent to their main house. Although it was late afternoon there were no signs of food preparation or cooking activity. The head's wife was menstruating and was confined to the rear of the main house. The other two families of the hamlet were sleeping at their garden houses so this family remained alone in the hamlet. Although the head and his eldest daughter (also the mother of an infant) were capable of cooking they chose not to on this occasion. At that time, this daughter was the subject of much criticism within the family - all relating to her reluctance to assist with garden work, collection of greens and cooking. They had eaten some roasted food earlier in the day but that night the family slept hungry. The next day brought a repeat of the situation but by then the younger children were agitating for food. One of the other hamlet families returned in the early afternoon and yam soup was offered by the woman of the other family. The soup was eaten but it was clearly insufficient for some of the older children who, late in the night, uprooted some sweet potato tubers from my kitchen garden.

- **Example 5.** This description relates to a meal some months later and after the young boy had been weaned (age at meal = 29 months). An evening meal of sago jelly, greens and tinned fish (plus other items) was prepared late at night without the help of moonlight or lamps. The young boy was given a plate (but no spoon) of sago by his mother. He sat down and ate the fish with his fingers then handed the plate to his father. His father then called for a spoon but the boy only used it to play with the sago as it was too hot. This play resulted in considerable spillage, which nonetheless was enjoyed by the family dog waiting close by. As the father finished his own meal the young boy began to spoon sago from his own plate to his father's. His father said nothing and in fact ate the sago! His father then finished off the boy's meal (the boy had walked away). A male neighbour came over to the hearth with a piece of fried sago and a chunk of coconut meat and gave it directly to the male head, who broke the sago into three pieces - for himself, his wife and son. The head ate all of the coconut meat. The young boy decided that he did not want all of the fried sago and handed it back to his father who ate it.
5.5 Short-term fluctuations in dietary intake

Under fives, and in particular the toddler group, experience many episodic, short-term fluctuations in dietary intake. These fluctuations are additional to the seasonal, intrinsic, and regular behavioural factors which produce a sub-optimal dietary intake pattern in the under fives. Some of the above examples refer to illness and menstruation as causes of dietary disruption. The following example quantifies the importance of these and other episodic factors.

Between October 1983 and August 1984, I observed 157 evening meals out of possible 336 eaten at a neighbouring hearth. Of the observed days, 40 meals (25.5 percent of the observed number) were not eaten by a small toddler (boy born 14.12.81). A significant reason was that on these occasions, the evening meal was prepared so late that he was asleep by the time it was ready (Figure 5-14). Late meal preparation related to maternal illness, and periods of heavy physical work by his mother suggested that she was fatigued. Other reasons included menstruation, thefts by the family dog, and illness in the child himself. The relative mix of contributing reasons for missed meals varies from child to child and over time, but illness (in the child) is consistently the most significant reason. Illness, appetite and nutrient intakes are discussed in more detail in the next chapter. The striking feature (as shown in this example) is that the smallest children experience the greatest degree of variation in food intake, a nutritionally disastrous feature - especially considering the need to maximise intakes at all times given the high-bulk, low-density foods eaten.

The above analysis of dietary intake patterns clearly implicates a number of factors in low energy and protein intakes: the nature of Abelam foods themselves; seasonal fluctuations in amounts eaten and in bulk-density values; a host of behavioural factors; and short-term fluctuations in dietary

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4Not assisted by the mother's dislike of all animal derived foods including tinned fish which undoubtedly contributed to her tiredness through nutritional stress. Attitudes towards foods were ascertained by adaptation of a technique developed by Fitzgerald (1977, 1978).
Figure 5-14: Reasons why a child did not eat a main meal, Oct 1983 - Aug 1984

- Meal cooked too late, child asleep
- Meal not eaten because of illness, mother's menstruation, animal thefts
intakes. Thus, the process of eating (or not eating) and the nutritional adequacy of that food in an under five year old depends on the type of food (and hence the season); whether a meal is prepared at all; how it is cooked, allocated and served; whether any assistance is given; and whether the child is ill. The amounts eaten are of course important also.

By controlling for a number of the above variables, I have developed three simple hypothetical dietary intake models to test the hypothesis that under certain specified conditions, it is possible to adequately nourish, in terms of energy and protein, all under fives, at 100 percent of the Harvard standard weight for age. The "specified conditions" are detailed in Chapter 2 but briefly, a diet has been devised taking into account cultural preferences, smoothing seasonal shortages of certain foods, and incorporating nutrition extension information widely known in Gwelikum.

The first version of the model is the tightest as it assumes that all under fives eat the same quantities of food all of the time. The second model relaxes this assumption and substitutes variable consumption according to age. The third model adds the empirically derived variable - meals foregone through illness - and is thus the closest model to Gwelikum reality (Figure 5-15).

The first two models are clearly unrealistic as all children do not eat the same quantities, nor do they eat three meals every day of the year. The third model demonstrates the major role of short-term interruptions in dietary intake on the capacity of under fives, and particularly toddlers, to meet energy and protein requirements. Thus, even in a controlled, "enhanced" diet, the intrinsic nature of the foods plus punctuated intakes are major reasons for low energy and protein intakes. Illness as a major variable in regulating dietary intake is discussed in the next chapter.
Figure 5-15: Percentage of energy and protein requirements met, models 1, 2 & 3
5.6 Summary

The richness and abundance of the Gwelikum diet is illusory when considered in relation to the under fives. It is true that the overall food supply seems adequate and diverse, but the under fives, and in particular the toddlers, do not eat enough food to meet minimum energy and protein requirements for all months.

The reasons for sub-optimal intakes are varied but can be placed under four categories: delayed introduction to and punctuated continuation of supplementary foods of restricted range; inherent problems with the food resource and seasonal variations in food bulk-density; a number of behavioural and practical obstacles which do not facilitate high food intakes; and major, short-term fluctuations in dietary intake, the most important cause being illness in the child.

A more detailed discussion of the many dimensions to illness is made in the next chapter, and the nature of child nurturing and its role in malnutrition is discussed in Chapter 7.
CHAPTER 6

DIMENSIONS OF MORBIDITY

The previous chapter suggested that short-term fluctuations (particularly illness related) in dietary intake are an important cause of sub-optimal energy and protein intakes in the under fives. Illness is not a constant variable however. Not all under fives suffer from the same diseases, nor are there common illness management approaches throughout the village. As a result of the differential occurrence and management of illness in some age sub-groups and individuals, there is a differential effect on dietary intakes. The relationship between sickness and malnutrition is the focus of this chapter.

6.1 The disease-malnutrition connection

The literature concerning the role of morbidity in the aetiology of malnutrition and vice versa is vast. Mata et al (1975:176) stated that infection aggravates malnutrition, and malnutrition accentuates the outcome of infectious disease is a readily accepted concept.

Although the disease-malnutrition vicious cycle is almost axiomatic, the fine details of many aspects of the operation of the cycle are not clear (Alpers 1981:3). To what extent is the nutritional status of a child the outcome of its disease history or the disease history the outcome of some increased likelihood of illness because of nutritional stress? Notwithstanding the difficulties in the apportionment of cause and effect, it is clear that some diseases may have direct nutritional outcomes. What is less clear is the direct role of nutritional status on the probability of becoming sick and dying. Morbidity risk in a PNG highlands area was higher in malnourished under-two-year-olds, with the second year of life the most severe (Bains &
Plate 6-1: A typical family
Crittenden 1985). In another PNG example, Sharp & Harvey (1980) concluded that *Plasmodium falciparum* malaria was a contributing factor to stunting of growth, this being most marked in children under two years of age. They considered that this may be due to retarded intrauterine growth although malaria may "exert a direct effect on growth in young children (p 132)". They also pointed out that it was not clear whether stunted children were "more susceptible to infectious illness in general, or malaria in particular (p 139)". In general, malaria may affect sufferers in a number of ways: appetite may be affected; anaemia, liver and spleen enlargement may result; it may affect the absorption of dietary protein (Scrimshaw et al 1968); and severe infections may increase vulnerability to infection with other pathogens (Lowman 1980). Intestinal parasites can also impair resistance to disease and Bell (1978) considered that any malnutrition programme should include early reduction of the parasite burden.

During infection, essential nutrients may be utilised at higher rates, they may be wasted, or metabolic pathways may alter (Beissel 1975), and this may even occur under conditions of adequate nutrition (Mata et al 1975:187). A long-term prospective Guatemalan study showed that the infection-malnutrition starts in utero, that post natal infections significantly affect the weight curve and that many seemingly benign illnesses in the well-nourished, when found in the malnourished, are often much more severe and prolonged and are associated with higher death rates (Mata et al 1975:191). Measles, in the malnourished, can be a very serious illness. Complications associated with measles include diarrhoea and bronchopneumonia, the former often directly causing PEM (Mackenzie 1978:6).

Quite apart from the biochemical, immunological, metabolic or other medical impacts of disease on nutritional status, disease may alter the behaviour and eating habits of the affected children. Appetite suppression during illness has been widely reported (Sharp and Harvey 1980, Mata et al 1975, Mackenzie 1978) and frequently, cultural factors lead to poor management of the sick (eg., withholding of certain foods during illness).
6.2 Historical aspects of morbidity and mortality in the Maprik area

Little is known of pre-contact disease patterns in the Maprik area but Kaberry's (1941a:238) ethnography noted that the main diseases were yaws, tropical ulcers and other sores, fever, respiratory disorders, and Tinea imbricata. As noted in Chapter 3, Gwelikum ethnohistorical evidence suggests the possibility of a smallpox epidemic in the 1890s. World War Two brought a severe form of dysentery which killed many children, some adults, and many old people (see Angau War Diary - AWD File 603/7/27, Annex. 2 to Appendix 10 and AWD, File 603/7/23 p.22 for references to the disease in the Gwelikum/Aupik area, and Allen (1983) for a discussion of the disease in the Dreikikir area to the west of Maprik).

Malaria was shown by early medical surveys to be the most important disease in the Maprik area, affecting mortality, morbidity, and fertility. In one study, spleen rates approached 100 percent in children under 9 years of age; high malaria parasite rates were identified; three species of malaria were present; multiple malaria infections were recorded with very heavy malaria infestations in many infants, even in very young ones (Peters and Standfast 1957). Peters (1960:259) concluded that a "...situation of true [malaria] holoendemicity exists in the [Maprik] area". Both Peters (1960) and Forge (1970) estimated that infant mortality rates were a little over 60 percent (with most dead before 15 months of age), and that malaria played a major role in this high rate. Peters (1960) noted an average of only 1.3 living children to every woman of child bearing age. Furthermore, he believed that the "...low figure of 3.1 live births per woman may also be partly attributed to the effect of malaria during pregnancy" (Peters 1960:244).

Another investigation revealed that women suffered significantly higher rates of enlarged spleens and livers and that this worsened with increasing parity. Protein deprivation was implicated in the aetiology of these syndromes (Schofield 1962).
Other diseases were also investigated. *Tinea imbricata* (a fungal skin disease) was widespread in the Maprik area, and it was noted that the onset of this disease was frequently preceded by a period of nutritional stress (especially in children under 2 years of age) and that in adults with *Tinea imbricata*, W/H ratios were significantly lower than in people not infected (Schofield et al 1963).

Other researchers noted that traditional birth and midwifery procedures led to high neonatal death rates caused by sepsis, tetanus and cord damage (Schofield and Parkinson 1963). They also remarked on the higher prevalence of bacillary dysentery in the dry season, occasional cases of infanticide and the efficacy of the anti-yaws campaign conducted in the early 1960s. This and the anti-tuberculosis campaigns were well received by villagers as was the DDT spraying which caused some "big-men" to remark to the researchers that their children seemed much healthier.

Some eastern Abelam villages (e.g., Wingei) had access to Aid Posts by about 1960 but others, not until much later. The Assemblies of God mission and the Catholic Church were also early providers of medical care. Access to primary health care facilities became important for most villages from 1960, and this, together with DDT spraying for malaria control clearly made a substantial impact on the very high infant mortality rates existing prior to intervention.

Malaria control through DDT spraying dramatically altered infant and toddler mortality patterns. Most of the early deaths in early childhood occurred before 12 to 15 months of age, and the strong suspicion of malaria as the main mortality cause was confirmed by 1963 when DDT spraying had caused a decline in infant mortality rates (Forge 1970:274-5). Yet, in spite of such high pre-intervention infant mortality rates, the Abelam population was growing at 1.8 percent per annum (based on data collected in Kalabu by Kaberry in 1938-9). Lea (1964:197) reported a rate of 2.8 percent between 1956-7 and 1961-2. With lowered infant mortality, the rate jumped to about
4 percent (Forge, in press), although census data suggest the overall annual rate of population increase between 1958-59 and 1980 was somewhat lower at 2.8 percent.

In spite of DDT spraying throughout the 1960s, spleen rates in under ten year olds were sufficiently high for Gorlin (1973) to still classify the South Wosera region as malaria holoendemic. He also confirmed Schofield's (1962) findings concerning the relationship between enlarged livers and lactation in women. Gorlin described a situation in which malaria had continued despite DDT spraying yet

...infant mortality rates which have shown steady and successive declines in each year from 1962-8, a change which is a familiar one that occurs generally when DDT spraying is introduced (Gorlin 1973:94).

The apparent persistence of malaria at least at holoendemic levels together with a simultaneous reduction in infant mortality rates due mainly to malaria control\(^1\) is a perplexing situation. More recent (mid 1970s) Abelam research by Scaglion (1978) concluded that “mortality rates for both neonates and young children is [sic] high (estimated at roughly 20 percent by the age of five... (p. 319)“.

In addition to published material suggesting a substantial fall in infant and toddler mortality since the early 1960s, detailed family history data (Table 6-1) and apparent changes in cultural explanations for infant/toddler death provide supporting evidence for the decline in mortality. It is likely that although older women underestimated births and deaths of infants, stated mortality in their children (34 percent) is significantly higher than with younger mothers. Twenty eight post-menopausal women lived in Gwelikum 2 in 1984. Of those, 11 (39 percent) were nulliparous (and all were married). This apparently high rate of infertility is probably much higher than the crude infertility rate and may reflect differential survival potential (ie., higher) of nulliparous women.

\(^1\)Other medical intervention measures such as tetanus toxoid injections given to pregnant women must have had an important impact on neonatal mortality.
Table 6-1: Fertility and child mortality, Gwelikum 2.

<table>
<thead>
<tr>
<th>Categories of Women (at 1984)</th>
<th>Fertility and Mortality Details (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Births/ Deaths/ Survivors/ % Dead</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>1. All mothers of &lt; 5s (n=28)</td>
<td>4.2 (2.4)</td>
</tr>
<tr>
<td>2. Mothers of under fives with completed reprodynamic lifespans (n=9)</td>
<td>5.9 (2.8)</td>
</tr>
<tr>
<td>3. Very old people, recalled data (n=8)</td>
<td>5.1 (0.78)</td>
</tr>
</tbody>
</table>

(1) Data obtained from interviews

(2) Deaths in early childhood. Generally taken to mean before age 5.

A decline in infant and early childhood mortality is suggested also by the change in traditional explanations of child death. Forge (1970:268) reported that during the late 1950s...

...about half of all live births died within a year or fifteen months, which is the period during which deaths are attributed to witches.

He also noted that although by 1963, DDT spraying was reducing infant mortality, the role of the witch (the *kutaakwa*) had not yet diminished in cultural importance. By 1984, the *kutaakwa*'s role in Gwelikum life was that of a more benign creature. She was rarely encountered, but if so, it was more in her role of confusing solitary walkers in the forest. It was often stressed to me that *kutaakwas* became rare when the shotgun was introduced; they became afraid and were found only occasionally. The shotgun became common at about the time of the introduction of DDT spraying and the provision of medical services, thus coinciding with the rapid fall in infant mortality. Similarly, "sudden death" sorcerers (the *waasakusndu*) had become rare because of a shortage of the all important arm bones of recently deceased infants. The shortage of this kind of sorcery material (*kus*), according to my informants, also meant a reduction in the frequency of
sudden deaths (eg., such as cerebral malaria). These are perfectly plausible (and logical) explanations for the decline of kutaakwa and waasakusndu and although the two did not work cooperatively together, the former provided the necessary raw materials for the latter. By 1984 there had not been a similar reduction in ordinary sorcerers (kusndu) who were responsible for slower deaths caused by diseases such as pneumonia. These types of diseases had not declined either!

It is clear that infant mortality declined substantially after about 1960. An important question however, is what types of children died in pre-intervention circumstances. Did malnourished children die at significantly higher rates than the less malnourished? Does the present substantial reduction in infant and early childhood mortality mean that the contemporary malnutrition problem may, in part, be a product of this process? Traditional and contemporary infant/toddler nurturing patterns are considered in more detail in Chapter 7. As a higher morbidity and mortality outcome is probable in the malnourished it is appropriate to seek out data from the Maprik area to test this hypothesis.

The following analysis draws upon the data of Schofield (1962), Bailey (1963), and Schofield et al (1963). These data represent various anthropometric and nutritional findings from pre-medical intervention and malaria spraying circumstances. As appropriate, data from Gwelikum (1983-84) are compared against these older data (Tables 6-2, 6-3, and 6-4). As there are no time series data for any of the communities concerned, inter-village comparisons are the only options available in this instance. The comparisons therefore do not take account of possible genetic and environmental differences between the villages. These variables are treated as constants.

Birth weights between Wingei and Gwelikum are not significantly different (Table 6-2). The higher weights of Wingei children at 9 months may indicate a higher proportion of malnourished children who had died, and
Table 6-2: Weights of children, Wingei, 1959-60 and Gwelikum, 1983-4, compared.

<table>
<thead>
<tr>
<th>Age</th>
<th>Details</th>
<th>Wingei 1959-60 (1)</th>
<th>Gwelikum 1983-4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean W/A wgt.</td>
<td>n Mean SD W/A wgt.</td>
</tr>
<tr>
<td>Birth</td>
<td></td>
<td>2.71 80</td>
<td>21 2.61 0.61 77 (2)</td>
</tr>
<tr>
<td>9 Mths</td>
<td></td>
<td>7.27 82</td>
<td>14 6.76 0.82 76</td>
</tr>
<tr>
<td>2 Yrs</td>
<td></td>
<td>8.95 72</td>
<td>20 9.59 0.81 77</td>
</tr>
</tbody>
</table>

(1) Schofield (1962), numbers and Std. Dev. unknown.

(2) Data from all hospital births and infants presented to either hospital or MCH clinic within 24 hours of birth (Gwelikum 1 & 2 combined).

hence were not included in the survey. Those who survived to 9 months, in the absence of medical facilities, continued to suffer untreated illness at high levels. By 2 years they had grown, but were lighter than their medically treated Gwelikum counterparts in 1983-4. By 1983-4, with much lower infant and toddler mortality rates, the 9 month values obviously include a notional mortality component which was naturally absent in the 1959-60 values.

Table 6-3: W/H ratios, children 6-12 months, Kalabu & Wosera, 1962, and Gwelikum, 1983-4, compared.

<table>
<thead>
<tr>
<th>Location</th>
<th>N</th>
<th>Mean Age in Mths (SD)</th>
<th>W/H Ratio - kg/cm (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kalabu, 1962 *</td>
<td>21</td>
<td>9.9 (2.68)</td>
<td>0.1100 (0.0089)</td>
</tr>
<tr>
<td>Wosera, 1962 *</td>
<td>17</td>
<td>9.3 (3.2)</td>
<td>0.1010 (0.0027)</td>
</tr>
<tr>
<td>Gwelikum, 1983-4</td>
<td>21</td>
<td>9.0 (2.0)</td>
<td>0.0998 (0.0109)</td>
</tr>
</tbody>
</table>

* Bailey (1963)

NB: Kalabu/Wosera differences significant, p < 0.01

Kalabu/Gwelikum " " " "

Wosera/Gwelikum differences not significant.

(t-tests)
Gwelikum infants in 1984 were significantly thinner than Kalabu infants of 1962 and about the same as the Wosera infants of 1962 (Table 6-3). It is possible that the higher W/H ratios of 1962 Kalabu reflect higher mortality in the lower W/H groups. The similarity between Gwelikum infants in 1983-4 and the Wosera infants of 1962 may merely reflect an even worse Wosera situation at that time. Alternatively, the Gwelikum conditions of 1984 may mirror the Wosera conditions of 1962.

One final comparison is the phenomenon "Failure to Gain Weight" (FGW) in young children discussed by Schofield et al (1963).

Table 6-4: "Failure to Gain Weight", under 2 year olds, Wingei/Wam, 1959-62, and Gwelikum 1983-4, compared.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Wingei/Wam * 1959-62</th>
<th>Gwelikum 1983-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 6 Months</td>
<td>2.4</td>
<td>Nil</td>
</tr>
<tr>
<td>7-24 Months</td>
<td>29.2</td>
<td>51.6</td>
</tr>
</tbody>
</table>

*Schofield et al (1963)

The difference between the two groups at the 7-24 months of age level is striking (Table 6-4). On these figures, Gwelikum toddlers in 1984 were almost twice as likely to experience FGW as were their 1959-62 counterparts. In 1959-62, the FGW group experienced higher mortality and hence is not recorded in the statistics. The higher overall survival potential of 1983-4 infants and toddlers ensures that these children with FGW are now included in the statistics.

Firm conclusions from the above three comparisons are not possible but in the absence of primary data concerning the nutritional status of dead children, a reasonable hypothesis is that malnourished children in the past, were more likely to die than well-nourished children. Thus, the whole anthropometric structure of the surviving children altered with changes to
mortality patterns. The malnourished now are more likely to survive than formerly and this in turn has created new problems in child nurturing.

In addition to probable changes in the early 1960s to anthropometric patterns in children, there appear to have been longer-term changes. The data are very scant however, and only tentative conclusions can be made. To my knowledge there are no prospective anthropometric studies from this area so I can only compare two cross-sectional samples, from two locations at two different times. Full adult anthropometric data for Gwelikum are shown at Appendix

Table 6-5: Adult anthropometry, Yenigo 1962, and Gwelikum 1983-4, compared.

<table>
<thead>
<tr>
<th>Age Group &amp; Sex</th>
<th>Mean Weight (kg)</th>
<th>Height (cm)</th>
<th>W/H ratio (cm/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men, 20-39 Yrs</td>
<td>54.5</td>
<td>156.2</td>
<td>0.35</td>
</tr>
<tr>
<td>Women, 20-39 Yrs</td>
<td>45.9</td>
<td>147.2</td>
<td>0.31</td>
</tr>
<tr>
<td>Yenigo, 1962</td>
<td>58.7</td>
<td>164.1</td>
<td>0.36</td>
</tr>
<tr>
<td>Gwelikum, 1983-4</td>
<td>50.2</td>
<td>150.3</td>
<td>0.33</td>
</tr>
</tbody>
</table>

* Bailey (1963:392)

Both men and women have become substantially taller and heavier since 1962, although height increases are much greater in men (Table 6-5). W/H ratios have changed little in men but W/H ratios in women have improved, although they are still less favourable than male ratios. Ross (1984) concluded that the W/H ratios of non-pregnant Wosera mothers were among the worst reported (in non-famine conditions). Ross (1984) demonstrated that mean heights of non-pregnant Wosera mothers have increased significantly over the comparable values reported by Bailey (1963), but commensurate mean weight increases were not as high, which has resulted in a deterioration of W/H ratios (from 87.6 to 85.6 percent of mean weight as a percentage of expected mean weight for mean height). Explaining these anthropometric
improvements is the subject of considerable research effort into the relative roles of improved nutrition and access to and utilisation of medical services (see Hide 1984).

6.3 The general health status of Gwelikum under fives

Gwelikum occasionally experiences epidemics or near epidemics. Apart from the probable smallpox epidemic of the 1890s and the dysentery outbreak during WW2, both of which resulted in many deaths, lesser epidemics have also occurred. In 1959, "an echo virus" (possibly dengue fever) swept through the district (Forge, in press), and in Gwelikum I observed minor epidemics of various diseases. In October 1983, an influenza type illness swept through the village, and between February and April 1984, many adults and most under fives were affected by severe leg sores, tropical ulcers, scabies, and exclusively in children, the wart-like virally caused skin disorder Mollusca contagiosum. Detailed examination of clinic books revealed that measles epidemics or events occurred in the periods March-May 1981 and August-September 1984. The second measles event was made possible by a sufficient build up of non-immune children (all were born after the first event) which facilitated transmission (see Black 1980:43 also).

Medical surveys.

The first clinical survey (February 1984) revealed very high malaria parasite rates, particularly Plasmodium falciparum, high numbers of anaemic children, high spleen rates (suggesting chronic malaria infection), and many children had heavy scabies infections (Table 6-6).

There has been a shift in the relative importance of different malaria species in the Maprik area since 1956 (Table 6-7). P. falciparum has become relatively more important; P. malariae was not detected in 1984, and multiple infections have become much less common. P. falciparum causes the most severe form of malaria in humans. In the 1984 survey, only 3 (10
Table 6-6: Results of medical examination of Gwelikum 2 under fives, February 1984.

<table>
<thead>
<tr>
<th>Details of disease or laboratory test</th>
<th>Number affected</th>
<th>Percent of total affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molluscam contagiosum *</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Tinea imbricata *</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Judged on exam. to be anaemic *</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>Heavy scabies infection *</td>
<td>16</td>
<td>37</td>
</tr>
<tr>
<td>Enlarged spleens *</td>
<td>30</td>
<td>70</td>
</tr>
<tr>
<td>Plasmodium falciparum *</td>
<td>30</td>
<td>70</td>
</tr>
<tr>
<td>Plasmodium vivax *</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Haemoglobin levels &lt; 10g/100ml **</td>
<td>36</td>
<td>84</td>
</tr>
<tr>
<td>Positive for hookworm in faeces *</td>
<td>5</td>
<td>16 ***</td>
</tr>
</tbody>
</table>

* Diagnosis and/or analysis performed by Maprik Hospital staff.

** Laboratory analysis performed by D Tyson at Maprik Hospital.

*** Percentage of cases sampled (n=32). N=43 for all other categories.
### Table 6-7: Malaria parasites, under fives, Maprik & Saragum, 1956, and Gwelikum, 1984, compared.

1. **Parasite Species**

<table>
<thead>
<tr>
<th>Location</th>
<th>Species frequency (%)</th>
<th>P. falcip.</th>
<th>P. vivax</th>
<th>P. malariae</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maprik/Saragum 1956</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2 yrs</td>
<td>45.2</td>
<td>25.8</td>
<td>25.6</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>2-4 yrs</td>
<td>42.2</td>
<td>20.0</td>
<td>35.6</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td><strong>Gwelikum 1984</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 5 yrs</td>
<td>90.9</td>
<td>9.1</td>
<td>Nil</td>
<td>Nil</td>
<td></td>
</tr>
</tbody>
</table>

2. **Multiple Infections**

<table>
<thead>
<tr>
<th>Location</th>
<th>Total with parasites (n)</th>
<th>Percentage infected with:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 sp. 2 sp. 3 sp.</td>
</tr>
<tr>
<td><strong>Maprik 1956</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 4 yrs</td>
<td>41</td>
<td>41 32 27</td>
</tr>
<tr>
<td><strong>Gwelikum 1984</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 5 yrs</td>
<td>33</td>
<td>97 3 Nil</td>
</tr>
</tbody>
</table>

* Peters & Standfast (1957: Table VI)
** Peters & Standfast (1957: Table VII)
percent) of *P. falciparum* positive cases were of the gametocyte\(^2\) stage of the parasite life cycle. Peters and Standfast (1957: Table VIII) reported 58.8 percent and 37.5 percent gametocyte rates in the under 2 year olds and 2-4 year olds respectively. They concluded that the main infective pool for malaria infection thus resided in these very young children. With only 10 percent of parasitised under fives positive for gametocytes, it is probable that the infective pool is now found mainly in other, older age groups. As the February 1984 survey did not include children over five and adults, no further conclusions are possible.

Although the positive intestinal parasite cases were identified as hookworm (*Necator americanus*), *Strongyloides* cannot be ruled out (T Brown, pers. comm. Feb. 1984) as the two species cannot be distinguished on the basis of their ova; examination of larvae is necessary (Jamison 1977:75). The relatively low hookworm infection rates (16 percent of cases examined) therefore does not explain the very high percentage of under fives (84 percent) with haemoglobin levels below 10g/100ml. Depending on the authority, a level below 10 or 11g/100ml indicates anaemia, which may result when red blood cells are destroyed by the malaria parasites. Splenic enlargement is the body's response to this red blood cell destruction. It is probable that malaria is the main cause of anaemia in Gwelikum under fives.

Haemoglobin levels and spleen size are analysed in further detail in Figures 6-1 and 6-2. Mean size of spleen enlargement increases slightly with increasing age, but the relationship is very weak \((r=0.289, r^2=0.08)\). Mean overall spleen size in 1984 was 2.17\(^3\), compared with 3.2 to 3.4 for under fours in 1956 (Peters and Standfast 1957: Table II). This analysis is inconclusive with no particular age group significantly higher or lower than the others. Most striking however, is that all sub-age groups, on average, are

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\(^2\)Only the gametocyte phase of the *Plasmodium* organism can infect the mosquito. The gametocyte then develops in the mosquito and in turn produces sporozoites which then infect a new host when bitten by the mosquito.

\(^3\)Method used was the widely used Hackett (1951) technique.
Figure 6-1: Spleen enlargement analysed by age group, under fives, Gwelikum 2, 1984.

ENLARGED SPLEENS
(excludes 13 children without enlarged spleens)
Figure 6-2: Haemoglobin levels analysed by age group, under fives, Gwelikum 2, 1984.
anaemic if judged by WHO standards (ie., <10g/100ml). Although there are no data for older children or adults, it is clear that anaemia is a problem with these age groups. A noticeable but unknown number of adult women were treated for anaemia during the fieldwork period with a peak in December 1983, the busiest food garden preparation month, and a time of consistently high physical demands on women.

The second clinical survey (July 1984) included all age groups, and although less detailed in the range of conditions evaluated, the under fives had high rates of scabies, malaria and respiratory symptoms, diarrhoea, and enlarged spleens (Table 6-8). I have no explanation for the lower spleen rates in the second survey other than the possibility of a less reliable assessment in the second survey4.

In summary, Gwelikum under fives are not a healthy group. They are typically parasitised by *P. falciparum* and have enlarged spleens, suggesting chronic infection. Malaria is clearly implicated in the aetiology of anaemia which affects the vast majority of children. Heavy scabies infections are common with very few under fives escaping this affliction. *Tinea imbricata* is present but not common in Gwelikum 2 under fives (it is more common in Gwelikum 1). Parasite and spleen rates were slightly lower in 1984 than in pre-intervention 1956 (see Peters and Standfast 1957) but *P. falciparum* had clearly become the dominant malaria type by 1984. Undoubtedly malaria prophylaxis and drugs to treat the illness have played a role in reducing these parasite and spleen rates, but given that many more chloroquin resistant strains of *P. falciparum* are emerging in the Maprik area, drug efficacy is declining and may decline further in the future.

Older children and adults are also significantly affected by scabies, *Tinea imbricata*, sores, splenomegaly, and malaria. These disorders however, are more prevalent in children under 15 years of age than in the older age groups.

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4The first survey was conducted by a doctor; the second by locally trained paramedics.
Table 6-8: Primary Health Care baseline medical survey, total population, Gwelikum 2, July 1984.

Survey Results Age groups (n). Total surveyed = 217

<table>
<thead>
<tr>
<th>Percent with:</th>
<th>0-5 yrs</th>
<th>6-15 yrs</th>
<th>16-40 yrs</th>
<th>&gt; 41 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>(Number)</td>
<td>22</td>
<td>(14)</td>
<td>(36)</td>
<td>(29)</td>
</tr>
</tbody>
</table>

- **Scabies**: 41 43 31 24 29 26 6 12
- **T. imbricata**: 27 7 19 3 3 17 Nil 20
- **Sores/T. ulcers**: 23 21 31 28 10 12 6 16
- **Enlarged spleens**: 50 36 47 41 3 17 Nil Nil
- **Malaria symptoms**: 27 7 14 31 23 14 11 12
- **Malaria & resp. symptoms**: 59 43 14 14 19 33 28 24
- **Diarrhoea**: 32 7 6 3 Nil 5 Nil Nil

* Malaria blood slides for determining parasite rates were also taken but at the time of writing the PNG IMR had not made the results available.
Analysis of clinic books

Seeking treatment for a child's illness is a significant demand on a mother's time. If considered in terms of hours spent by the child's mother, during the review period (August 1983-August 1984), each mother spent an average of 92 hours in having her child's various illnesses treated. Each mother averaged 29 trips to the Aupik aid post and 13 trips to the MCH clinic. If time spent on seeking treatment for her other children and herself is included, total time devoted to illness management is very high.

During the review period there was a total of 850 treatment days, and of these 672 (79 percent) were for fever (either alone or in conjunction with respiratory/diarrhoeal symptoms) (Figure 6-3). On average, each month "consumed" 65 treatment days from Gwelikum 2, or 1.9 days per child. This is 6.3 percent of total days (or 8.8 percent of APO working days). Days spent on traditional treatment are unknown.

Children suffer distinctly different patterns of illness at different ages (Figure 6-4). Toddlers (7-24 months) have the highest rates of malaria, respiratory disorders and diarrhoea. All illness categories are negatively correlated with age, although malaria declines less rapidly with age. This is consistent with reported spleen rates (Table 6-6). Infants (0-6 months) have slightly lower sickness rates than toddlers, due in part to maternally imparted immunity. Respiratory disorders and diarrhoea at Gwelikum are thus diseases of toddlers.

There is no linear association between sickness treatment days and nutritional status (W/L) in under fives (n=29, r = -0.22, r2=0.05). With toddlers, who have the highest rates of wasting and the highest morbidity rates, the Gwelikum 2 sample size (n=15) is too small for comprehensive analysis of any possible association between nutritional status and sickness treatment days. When each child's mean L/A and W/L for the review period is examined in relation to mean monthly treatment days (full data are shown

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5 An example of clinic book entries is shown at Appendix C.
Figure 6-3: Sickness treatment days, under fives, August 1983-August 1984, Gwelikum 2.
Figure 6-4: Morbidity patterns, analysed by age class, under fives, Gwelikum 2.
in Appendix D), the relationship is not linear (L/A X treatment days, r=-0.12; W/L X treatment days, r=0.25). Indeed, the majority of toddlers receive about the same level of medical treatment and are very close anthropometrically.

Although there is a central tendency in both treatment days and nutritional status, a number of outliers or anomalous cases in the small toddler sample, along with sample size itself, account for the non-linearity of association between nutritional status and sickness treatment days. Of the 15 toddlers, 7 were "abnormal" in either nutritional status or treatment days, or both. These are:

1. Above average treatment days.
   - Child no. 9 Wasted, not stunted (good length)
   - Child no. 8 Normal

2. Average treatment days.
   - Child no. 4 Wasted, not stunted
   - Child no. 12 Slightly stunted, not wasted

3. Below average treatment days
   - Child no. 10 Stunted, not wasted
   - Child no. 5 Stunted, not wasted
   - Child no. 14 Normal

It would be expected a priori that shorter-term malnutrition (ie., low W/L) would be negatively correlated with sickness treatment days. Longer-term nutritional stress (ie., low L/A) would also be negatively correlated with treatment days but the relationship would be much weaker. The families and some aspects of the disease histories of the above children were known to me (Appendix E shows growth, treatment days, and other data for the above children), and conclude that these abnormal cases are explained by:

1. differences in morbidity between individuals of similar anthropometry (eg., numbers 8 & 14)
2. differences between morbidity experienced and treatments received (eg., numbers 5 & 10)

3. non-morbidity factors such as nurturing practices (eg., numbers 4 & 12).

Although the general relationship between nutritional status and morbidity is unclear in Gwelikum under fives generally and toddlers in particular, the fungal skin disease *Tinea imbricata* is clearly associated with malnutrition (Table 6-9). The data however, are insufficient to determine whether the disease causes malnutrition or is the outcome of nutritional stress. Earlier research suggests that *Tinea imbricata* is associated with low W/L ratios in adults and frequently first appears in toddlers after a period of nutritional stress (Schofield et al 1963; Gorlin 1973, 1977).

**Table 6-9: Tinea imbricata and nutritional status, under fives, Gwelikum 1 & 2.**

<table>
<thead>
<tr>
<th>Details of Infection</th>
<th>Mean Age (SD)</th>
<th>Nutritional Status</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present (n)</td>
<td>36.9 (14.0)</td>
<td>Normal: 5, Malnourished: 13</td>
<td>18</td>
</tr>
<tr>
<td>Absent (n)</td>
<td>29.4 (16.2)</td>
<td>48, 32</td>
<td>80</td>
</tr>
<tr>
<td>Total</td>
<td>53, 45</td>
<td>98</td>
<td></td>
</tr>
</tbody>
</table>

* Waterlow classification aggregated. Includes: wasted only, stunted only, wasted & stunted.

(Chi-squared=6.41, p<0.02)

Malaria is the most significant disease of the under fives but the relationship between malaria and nutritional status cannot be demonstrated from the small sample. However, the positive nutritional effects of minimal malaria infection are suggested by a small number of cases (n=3) identified in the analysis of all available clinic books (n=60). Three cases (two of whom were brothers) were striking in that there were no entries for either malaria prophylaxis or treatment, yet the books contain an almost full series
of MCH weight entries for the first 33 months of life for the three. After that, the entries are more sporadic. In all three cases, I initially suspected that the absence of any entries for malaria treatments merely indicated a failure to seek treatment and that the children still suffered from malaria. However, these boys had a growth record (weights) which was substantially better than the Gwelikum average performance (Figure 6-5). Detailed discussions with both sets of parents revealed that these children had slept under mosquito nets consistently since birth and both families always carried supplies of the then effective drug chloroquin which were administered in the event of the occasional malaria attack. The parents were very proud that they had been able to prevent or ameliorate malaria in their children. It is not known whether the children subsequently acquired immunity to malaria. Both fathers were village Health Committee officials and had tried unsuccessfully to convert other villagers to their own malaria control practices.

By comparison with the Gwelikum average, the nutritional status of these three boys was significantly better than their peers and certainly fully within the “well nourished” category. The variability between the three boys was very low with a mean standard deviation between them over time of only 4.5 percent. Several points emerge from this case. Growth in a malaria controlled/free environment is likely to be substantially greater, although the improved growth of these children may be due also to more effective parenting practices associated with heightened awareness of child malnutrition and sickness. The children are well nourished but they still fall below 100 percent of the Harvard weight-for-age standard. Furthermore, the widely reported toddler growth failure pattern is still evident so non-morbidity factors are also implicated in sub-optimal growth performance.

In summary, although there are inherent problems with the clinic book data base and small sample size, it is still possible to draw a number of conclusions. Morbidity has a seasonal dimension, “epidemics” sometimes
Figure 6-5: Mean W/A growth curve for three minimally malaria affected children, Gwelikum 2.
occur, and malaria is the most significant disease of the under fives. Illnesses of all kinds are negatively associated with age in the under fives, and the toddler group experiences the greatest number of all disease types. Linearity of association between apparent morbidity (i.e., "treatment days") and W/L & L/A is not revealed in an analysis of clinic books but this is accounted for by small sample size and by differences in morbidity between individuals (independent of nutritional status), the extent to which treatment is always sought, and non-morbidity factors such as nurturing. Malaria appears to significantly affect growth. However, even in children who have been protected against the disease, the children still grew sub-optimally and reflected the same toddler growth failure pattern so typical of Gwelikum and other populations in Papua New Guinea. It is unlikely that morbidity alone explains the aetiology of child malnutrition in Gwelikum.

6.4 Specific realities of illness and its management

The previous section demonstrated that the under fives and in particular the toddler age group carry a higher sickness burden than other age groups. By shifting the focus towards illness as a condition or state within a behavioural and cultural context, I aim to demonstrate that there is considerable variation within Gwelikum as to the perception and management of illness in children. Thus, culture is an important dimension to morbidity and through this culture mediation, there is a variable disease (and hence nutritional) outcome in under fives.

The villagers have little difficulty in recognising their main diseases (35 different disorders are listed in Appendix F). In general, sickness detection and classification is based on recognition of physical and behavioural symptoms. Identifying the cause, and hence the appropriate response, is somewhat different. No sharp distinction is made between organic/biological and supernatural cause or treatment approach. Treatments and responses are drawn from a multi-dimensional environment which includes inanimate
objects, medicinal plants (Appendix G), spiritually charged plants (see Stocklin, in press), humans with special wisdom or skills, the power of dreams and premonitions, humans capable of invoking supernatural powers, and the various spirits themselves. Notwithstanding the well-intentioned responses by parents to illness in their children, a number of phenomena were noted which either exacerbate or attenuate the course of an illness in some children.

Before discussing these phenomena, it is necessary to briefly discuss the main observable behavioural consequence of illness in under fives. Some diseases have little or no perceptible effect on a child's behaviour whereas others have significant effects. Those with little apparent influence on behaviour include: *Tinea imbricata*, mild respiratory disorders, minor scabies infections, sores and tropical ulcers, and *Molluscum contagiosum*. Diseases with significant effects on behaviour include: malaria, severe respiratory disorders, measles, dehydration due to diarrhoea, and scabies infestations which have become infected. The most commonly occurring and most significant behavioural change is appetite suppression (anorexia). Although this phenomenon has been widely reported, Martorell et al (1980:349) stated that

...many textbooks and articles point out that illnesses will be accompanied by anorexia and reduced dietary intakes. Yet we are unaware of any study which has provided the necessary data to estimate the mean impact of ordinary illnesses on the dietary intakes of chronically malnourished populations.

In their research on Guatemalan pre-school children Martorell et al (1980:345) found that "...the presence of selected symptoms was associated with an average reduction in daily intake of nearly 20 percent..." Gwelikum data derived from long-term observations (Chapter 5) suggested that up to 25 percent of meals were not eaten by under fives and that in many children this was largely due to illness-induced anorexia. As morbidity is significantly higher in the toddler group, anorexia, and hence reduced nutrient intake, is particularly important. With malaria, because of its
recurrent and long-lasting effects, anorexia is a major outcome. I saw many children with infected scabies; if left untreated, listlessness and anorexia appeared to be a frequent outcome. Uninfected scabies infestations did not seem to have any such behavioural effects. Episodic illnesses (as distinct from chronic infections) such as dysentery and measles were observed to produce anorexia but as they are usually short-term illnesses, their overall impact was less significant. In some children however, severe diarrhoea was the direct cause of short-term wasting, lethargy, and hence appetite suppression. Disease also has important physiological and hence metabolic effects but these are clearly outside the scope of this thesis.

A number of behavioural or management factors produce variation in disease duration and effect. These factors are additional to intrinsic variability between children (which is outside the scope of this thesis). Two groups of factors were observed in treatment responses affecting sickness intensity and duration, and dietary regulation during illness. These are discussed below.

Untreated, delayed and incomplete illness treatments are important sources of variation in illness severity, duration, and hence likely nutritional consequence. Many mothers⁶ do not seek treatment for illness in their children, or if they do, it may involve long delays between illness onset and treatment. Two case studies based on matching my daily diary entries for two children in a neighbouring house with clinic book entries illustrate these phenomena (Table 6-10). Overall, I estimate that approximately 33 percent of illness days in under fives are not treated, and of those days where treatment occurred, up to one third involved "delay days". The pattern varies however, from mother to mother. In the two examples, the boy's mother delayed seeking treatment but eventually sought treatment for a higher proportion of illness in her child than the girl's mother who sought

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⁶Seeking illness treatment is invariably a mother's task. Fathers may play a role in the decision to seek treatment but rarely take their children to the aid post. They may take their child to Maprik Hospital however, but prefer to do so on Fridays - market day - a practice which sometimes means that an illness is untreated for several days.
Table 6-10: Observed illness days and actual treatment days, Sept 1983 to Sept 1984, in two under fives, Gwelikum 2.

<table>
<thead>
<tr>
<th>Details</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>Born</td>
<td>Born Dec 1981</td>
</tr>
<tr>
<td>Observed illness days (n)</td>
<td>27</td>
</tr>
<tr>
<td>Treatment days per clinic book (n)</td>
<td>20</td>
</tr>
<tr>
<td>Illness days untreated: (n)</td>
<td>7</td>
</tr>
<tr>
<td>: (%)</td>
<td>26</td>
</tr>
<tr>
<td>Delay days *</td>
<td>6</td>
</tr>
<tr>
<td>Delay days as a percentage of treatment days</td>
<td>30</td>
</tr>
</tbody>
</table>

* Difference between date when illness observed and date of first treatment.
fewer but undelayed treatments. A further very serious problem is the failure to complete a course of medication. It is rare for a mother to walk from her hamlet to Aupik Aid Post each day for three to five days for malaria treatment (or malaria prophylaxis each week) or antibiotics for her child. The mother usually seeks medical attention for her child for one to two days, then with a reduction in symptoms, she discontinues treatment. The illness often continues, particularly in malaria cases. APOs and Hospital staff will not issue the mother with a full course of medication unless they can be convinced that drugs will not be taken all at once or taken by another person.

There are usually reasons for non-treatment of illness in children. Most of the reasons arise from pessimistic prognoses rather than simple disinclination to seek treatment. Another common reason is the reluctance of a mother to subject her child to momentary distress at the aid post (the prospect of an injection or even oral medication usually creates fear in the young child) even though the illness effects may be longer and more stressful on the child. Many people regard dreams as important tools for understanding disease causation, its likely outcome, and in the case of death, for divination. If a sick person dreams of sorcery (kustu), then sorcery rather than cursing (tewiya) is thought to be the likely cause. Dreams figure prominently in daily conversation: people share their dream sequences and the ensuing discussions and interpretations can be significant to the physical well-being of people. The power of dreams is unquestionned and any dream ex post facto is just as important as any premonition. Similarly, the "dreams" arising from fever-induced hallucinations are heeded. Thus, the dream is of great predictive and explanatory power. I witnessed an example of the influence of dreams in October 1983.

A ten month old child died soon after my arrival in Gwelikum. The child's mother had been widowed six months earlier. Just prior to her husband's death, he dreamed that in the near future, after his death, he would call for his young daughter to join him. He told his wife and others of his dream. The infant was plagued with
respiratory problems, almost from birth, and had been hospitalised with pneumonia. After the dying man's premonition, the mother resigned herself to her child's likely death. A number of dreams reinforced this view. Two weeks before the child died, the mother and infant were returning from Maprik market where they had purchased some dried fish. On the return journey, a large hawk swooped down on the mother and child, grasping a fish fillet held by the child. When details of this incident spread, it was generally regarded as an omen. The most common interpretation was that the hawk was the child's father and that he was now ready for the child to join him. Another woman claimed that she saw the dead man's spirit near the widow's house. This was further evidence that the child's death was near. Two weeks later the child died of pneumonia. Medical treatment was not sought after the hawk incident. The mother had obviously decided that the child's fate had been resolved and that she was not in a position to alter that fate. I was in the village during the course of these later events and was aware of the hawk incident interpretation before the child's death. After the death however, many people spoke of dreams which supposedly foretold the outcome and these dreams assumed equal importance.

Delays in seeking treatment may be due to a number of factors. Early symptoms may not be sufficiently indicative of the seriousness of the illness - many early-stage malaria attacks present as mild diarrhoea or as mild respiratory conditions, both of which are so common as to be virtually normal illnesses in the under fives. Other reasons for delay include prior work or other commitments; weekends (the aid post operates a 9 day fortnight but sometimes the aid post orderly is simply absent without reason); disinclination; and preference for traditional bush medicines. Although bush medicines are still used, they are rapidly taking a secondary role in illness treatment (cf. Stocklin, in press). The most commonly used bush medicines in 1984 were for treating cuts and sores. Bush medicines for malaria and severe respiratory illnesses such as pneumonia are almost always "last resort" treatments - after Western treatments have been tried and failed. Further "last resort" treatments in severely ill people (including children) who have been cursed is "group blowing" (de yapavu or nawure) of the victim's food, tobacco or betel nut by all "big men"; or in the case of sorcery victims, other elaborate redemption methods (see Forge 1970).

The "fatalistic" behaviour often reported in many traditional societies (eg., Oxer 1965) may partly result from clear, culturally defined options or pathways. Western observers are frequently exasperated by the apparent failure of people to "respond" to sickness. They fail to appreciate that the sufferer or caretaker of the ill person may have "responded", but in a different way.
Quite apart from the various treatment responses discussed above, many parents practise various forms of dietary regulation with their sick children. Although details differ according to the illness and from family to family, the element common to all is some form of dietary restriction or subtraction. This is a widely reported phenomenon (Jerome et al 1980:19) as is the use of foods in healing. Foods specifically identified with healing are few, the main one being the red-leaf form of *Gnetum gnemon* which is eaten when “blood is short” (anaemia). The symbolic relationship between certain common traits of both the disease and the cause or cure is widely recognised and is known as the “Doctrine of Signatures” (Farb & Armelagos 1980:86). In this case the common trait is colour: blood is red as is the leaf. In the case of dietary restriction or subtraction, foods with traits similar to the essential characteristics of the disease are avoided. In a sense, it is a reverse form of homeopathy which works on the principle that a disease or disorder should be treated with small quantities of drugs, which in a healthy person produce symptoms similar to the disease. Dietary regulation is most commonly seen in children with scabies and *Tinea imbricata*. Both diseases cause the sufferer to almost incessantly scratch the affected parts, and if the skin is broken, secondary infections often arise. Foods with irritant qualities include: pumpkin tips (furry leaves), *Ficus sp.* leaves and fruits (furry leaves), fresh and tinned fish (scales), taro (oxalic acid), mature coconut meat and its water (reason unknown), some yam varieties (bitter aftertaste), mangoes (turpentine taste), guavas (acidic when unripe), pawpaw (reason unknown), and wild passionfruit (bitter, toxic). Some of the fruits are introduced so it is possible that much contemporary dietary regulation in illness is relatively recent. Many parents restrict some or all of these foods if their children are affected by these skin disorders. As most under fives inevitably become infected with at least scabies, they are affected by dietary regulation, and in children with chronic infections, dietary restriction may be long-term. Other illnesses may alter dietary patterns. Local freshwater fish, and even tinned...
fish are avoided in severe cases of respiratory infection (and some people believe that fish causes respiratory illness), but the extent to which this is observed varies considerably between families.

The general pattern which emerges from the foods-sickness relationship is that some foods are seen as causes of certain illnesses, and should thus be omitted from the diet as part of the treatment. Dietary prescriptions, or additions to the diet during illness are noteworthy by their virtual absence in the response to illness.

6.5 Summary

Under fives are challenged by many types of disease and at higher rates than other age groups. The toddlers are the worst affected of the under fives, and of the diseases, malaria is the most significant. Although toddlers are the most affected group and are the most wasted children, the small data set does not quantify the extent of the morbidity-malnutrition relationship.

On the other hand, high morbidity is clearly associated with one important observable effect - anorexia and the nutritional consequences of reduced dietary intakes in young children due to anorexia have been demonstrated in the previous chapter. The anorexic response is not a constant variable - the way in which sickness is managed has various effects on the intensity and duration of illness and associated dietary behaviour.

In addition to some parenting behaviour which is specific to illness, there are more pervasive and fundamental features of child nurture which nutritionally disadvantage the under fives and in particular, infants and toddlers. These are considered in the next chapter.
## APPENDIX C

### AN EXAMPLE OF MCH CLINIC BOOK ENTRIES

Male child, born 14 December 1981

<table>
<thead>
<tr>
<th>Date</th>
<th>Weight (kg)</th>
<th>Details of illness, other notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.1.82</td>
<td>3.6</td>
<td>Fever, diarrhoea</td>
</tr>
<tr>
<td>8.2.82</td>
<td></td>
<td>Diarrhoea</td>
</tr>
<tr>
<td>16.2.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.82</td>
<td>5.2</td>
<td>Conjonctivitis</td>
</tr>
<tr>
<td>13.4.82</td>
<td>6.1</td>
<td></td>
</tr>
<tr>
<td>11.5.82</td>
<td>6.2</td>
<td>On ripe banana</td>
</tr>
<tr>
<td>8.6.82</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>21.8.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.8.82</td>
<td></td>
<td>Fever, temp. 36.4</td>
</tr>
<tr>
<td>23.8.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.8.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.7.82</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>16-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.7.82</td>
<td></td>
<td>Fever, cough, vomiting, respiratory distress</td>
</tr>
<tr>
<td>10.8.82</td>
<td>6.9</td>
<td>Fever, diarrhoea</td>
</tr>
<tr>
<td>14.9.82</td>
<td>7.0</td>
<td>Cough, diarrhoea</td>
</tr>
<tr>
<td>5-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.10.82</td>
<td></td>
<td>Strong cough</td>
</tr>
<tr>
<td>7-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.10.82</td>
<td>7.7</td>
<td>Pneumonia</td>
</tr>
<tr>
<td>9.11.82</td>
<td>7.9</td>
<td>Soree on hands</td>
</tr>
<tr>
<td>13.12.82</td>
<td></td>
<td>Strong cough</td>
</tr>
<tr>
<td>3.2.83</td>
<td>7.8</td>
<td>Infected scabies</td>
</tr>
<tr>
<td>21-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.3.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.83</td>
<td></td>
<td>Fever, short of breath</td>
</tr>
<tr>
<td>22.3.83</td>
<td></td>
<td>Fever, temp. 39.0</td>
</tr>
<tr>
<td>23.3.83</td>
<td></td>
<td>Stomach ache</td>
</tr>
<tr>
<td>24.3.83</td>
<td></td>
<td>Weakness, dizziness, anaemia. Admitted to Maprik Hospital with malaria and anaemia. Discharged after 3 days</td>
</tr>
<tr>
<td>7.4.83</td>
<td>7.9</td>
<td>Cough</td>
</tr>
<tr>
<td>11.5.83</td>
<td></td>
<td>Fever, temp. 37.6</td>
</tr>
<tr>
<td>16.6.83</td>
<td>9.1</td>
<td></td>
</tr>
<tr>
<td>8.8.83</td>
<td></td>
<td>Fever, temp. 40.0</td>
</tr>
<tr>
<td>10.8.83</td>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>14.9.83</td>
<td>9.2</td>
<td>Fever, cough, temp. 36.0</td>
</tr>
<tr>
<td>12.10.83</td>
<td>9.0</td>
<td>Cough, conjunctivitis</td>
</tr>
<tr>
<td>17.10.83</td>
<td></td>
<td>Dysentery, fever, temp. 39.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Admitted to Maprik Hospital on 17.10.83 Vomiting a lot. Diarrhoea as well. Conjunctivitis. Released on 24.10.83</td>
</tr>
</tbody>
</table>
# APPENDIX D

## GROWTH AND ILLNESS DATA FOR GWELIKUM 'TODDLERS'

<table>
<thead>
<tr>
<th>Child</th>
<th>Sex</th>
<th>DOB</th>
<th>Mean W/L</th>
<th>Illness treatment days/month</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>%</td>
<td>z score</td>
</tr>
<tr>
<td>1</td>
<td>M</td>
<td>12/81</td>
<td>82.8</td>
<td>-0.5</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>3/83</td>
<td>80.2</td>
<td>-0.8</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>1/82</td>
<td>85.5</td>
<td>-0.2</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>5/83</td>
<td>73.3</td>
<td>-1.6</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>3/82</td>
<td>97.8</td>
<td>1.2</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>2/83</td>
<td>87.0</td>
<td>-0.1</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>10/82</td>
<td>86.8</td>
<td>0.8</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>7/82</td>
<td>94.6</td>
<td>0.8</td>
</tr>
<tr>
<td>9</td>
<td>M</td>
<td>4/83</td>
<td>76.8</td>
<td>-1.2</td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>3/82</td>
<td>103.8</td>
<td>1.8</td>
</tr>
<tr>
<td>11</td>
<td>F</td>
<td>11/81</td>
<td>83.3</td>
<td>-0.5</td>
</tr>
<tr>
<td>12</td>
<td>F</td>
<td>9/82</td>
<td>83.6</td>
<td>-0.4</td>
</tr>
<tr>
<td>13</td>
<td>F</td>
<td>6/83</td>
<td>85.5</td>
<td>-0.2</td>
</tr>
<tr>
<td>14</td>
<td>F</td>
<td>9/81</td>
<td>103.7</td>
<td>1.8</td>
</tr>
<tr>
<td>15</td>
<td>F</td>
<td>9/82</td>
<td>88.2</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**Note:**

(1) Mean W/L values are values over time for each child while in the "toddler" age group.
APPENDIX E

GROWTH RECORDS FOR SEVEN SELECTED GWELIKUM UNDER FIVES

Yollin, female, date of birth Sept 1981

Elsia, female, date of birth 6-5-83

Jones, male, date of birth 6-7-82

Sipek, female, date of birth 29-2-82
APPENDIX F

DISEASES RECOGNISED IN GWELIKUM

<table>
<thead>
<tr>
<th>Samukundi Abelam Term</th>
<th>Probable Disease or Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apandang/Apangrelbandi</td>
<td>Malnutrition</td>
</tr>
<tr>
<td>Ayrek</td>
<td>TB, strong cough</td>
</tr>
<tr>
<td>Banguinguiwaasi</td>
<td>Leprosy, lasting sore</td>
</tr>
<tr>
<td>Biambakian de kakraleremuk</td>
<td>Stillborn baby</td>
</tr>
<tr>
<td>Biambando</td>
<td>Stomach pain</td>
</tr>
<tr>
<td>Deengreek</td>
<td>Diarrhea</td>
</tr>
<tr>
<td>Gumbirruk/kwakia</td>
<td>Papaloma fungus on soles of feet</td>
</tr>
<tr>
<td>Gwi</td>
<td>Runny nose</td>
</tr>
<tr>
<td>Ikki</td>
<td>Boil in groin lymph nodes</td>
</tr>
<tr>
<td>Kiaklandio</td>
<td>Illness, malaria</td>
</tr>
<tr>
<td>Kotn'bu</td>
<td>Tinea imbricata</td>
</tr>
<tr>
<td>Kwatiduaru</td>
<td>Aching joints</td>
</tr>
<tr>
<td>Kundibukapkuwa</td>
<td>Unable to talk</td>
</tr>
<tr>
<td>Koamsip'</td>
<td>Measles</td>
</tr>
<tr>
<td>Mael’nbakanguldio</td>
<td>Pneumonia</td>
</tr>
<tr>
<td>Minirimuyaagwa</td>
<td>Yellow eyes (jaundice)</td>
</tr>
<tr>
<td>Minindi</td>
<td>Conjunctivitis</td>
</tr>
<tr>
<td>Maaknaduaru</td>
<td>Headache</td>
</tr>
<tr>
<td>Maul’kanguldio</td>
<td>Chest pain</td>
</tr>
<tr>
<td>Ramu</td>
<td>Menstruation</td>
</tr>
<tr>
<td>Sik Muruk (pidgin)</td>
<td>Epilepsy. Abelam term unknown</td>
</tr>
<tr>
<td>Silplassik</td>
<td>Boil in armpit lymph nodes</td>
</tr>
<tr>
<td>Sit’ngu</td>
<td>Molluscum contagiosum</td>
</tr>
<tr>
<td>Tombekgwuyenbandi</td>
<td>Senile person</td>
</tr>
<tr>
<td>Wultumandu/taakwa</td>
<td>Obesity</td>
</tr>
<tr>
<td>Walosi</td>
<td>Scabies, strong sore</td>
</tr>
<tr>
<td>Winwaasi</td>
<td>Tropical ulcer</td>
</tr>
<tr>
<td>Windi</td>
<td>Blood in diarrhea</td>
</tr>
<tr>
<td>Winwudnya</td>
<td>Blood in urine</td>
</tr>
<tr>
<td>Windikiliignak</td>
<td>Anaemia</td>
</tr>
<tr>
<td>Walendu</td>
<td>Smallpox?</td>
</tr>
<tr>
<td>Waasi</td>
<td>Gen. for sore</td>
</tr>
<tr>
<td>Yaat</td>
<td>Cold/influenza</td>
</tr>
<tr>
<td>Yipmanakiakiandio</td>
<td>Fever with malaria</td>
</tr>
<tr>
<td>Yigunmalei</td>
<td>Healthy, gen. for very good</td>
</tr>
</tbody>
</table>
### APPENDIX G

**TRADITIONAL PLANT MEDICINES IN GWELIKUM**

<table>
<thead>
<tr>
<th>Name</th>
<th>Growth form</th>
<th>Disorder treated</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kamb'wara</td>
<td>H</td>
<td>Sores, cuts</td>
<td>Sap, topical</td>
</tr>
<tr>
<td>Kowa</td>
<td>T</td>
<td>Fresh cuts</td>
<td>Hot leaf compress, lime added</td>
</tr>
<tr>
<td>Waitum</td>
<td>V</td>
<td>Diarrhoea</td>
<td>Bark infusion, oral</td>
</tr>
<tr>
<td>Kusabaka</td>
<td>T</td>
<td>After birth</td>
<td>Bark infusion, bathe</td>
</tr>
<tr>
<td>Sarambiak</td>
<td>V</td>
<td>Scabies</td>
<td>Sap, oral</td>
</tr>
<tr>
<td>Koamb'</td>
<td>T</td>
<td>Scabies</td>
<td>Sap, oral</td>
</tr>
<tr>
<td>Kul'k'</td>
<td>H</td>
<td>Headache</td>
<td>Hot leaves to forehead</td>
</tr>
<tr>
<td>Kanda</td>
<td>T</td>
<td>Headache</td>
<td>Bark infusion, oral</td>
</tr>
<tr>
<td>Niangula (1)</td>
<td>T</td>
<td>Pneumonia</td>
<td>Bark infusion, oral</td>
</tr>
<tr>
<td>Newi (2)</td>
<td>T</td>
<td>Pneumonia</td>
<td>Bark infusion, oral</td>
</tr>
<tr>
<td>Maam (2)</td>
<td>T</td>
<td>Pneumonia</td>
<td>Bark infusion, oral</td>
</tr>
<tr>
<td>Waamb'</td>
<td>C</td>
<td>Sore throat</td>
<td>Pulp chewed</td>
</tr>
<tr>
<td>Nimilipng'i</td>
<td>(3)</td>
<td>Tinea imbricata</td>
<td>Leaf juice, painted on skin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Head lice</td>
<td>Sap, rubbed in hair</td>
</tr>
<tr>
<td>Numbulungwat</td>
<td>(3)</td>
<td>General pain</td>
<td>Leaves to affected area</td>
</tr>
<tr>
<td>Stinging nettles</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ningwus (Tobacco)</td>
<td>H</td>
<td>Sores, cuts</td>
<td>Juice applied</td>
</tr>
<tr>
<td>Maasa (Betel nut)</td>
<td>T</td>
<td>Snakebite</td>
<td>Juice &amp; lime applied to bite</td>
</tr>
</tbody>
</table>

* H = herb, T = tree, V = vine, C = cane, S = shrub

(1) First stage of illness

(2) Used later, when recovery under way

(3) Now very rare in Gwelikum forests
Although the previous chapters have identified a number of specific and important contributory factors in the poor nutritional status of Gwelikum under fives, the general nature of early child rearing practices must be evaluated also. Nurturing patterns vary cross-culturally and some researchers (e.g., LeVine & LeVine 1963; LeVine 1977; McKee 1984; Lepowsky 1985) have identified patterns which appear related to morbidity and mortality risks of the children concerned.

The contemporary mother is confronted with infant and child demography considerably different than that of her mother and grandmother. Modern health care is an important part of daily life and because of this, there are more surviving (but malnourished) children. To what extent can the "nurturing process" be implicated in the aetiology of early childhood malnutrition in the Abelam? A number of hypotheses are presented below, but more cross-cultural (within PNG particularly) ethnographic and psychological studies are necessary for a more comprehensive appraisal of these hypotheses.

Soon after arriving in the village, I had a chance meeting and discussion with a New Zealand missionary with 15 years experience in the North Wosera Census District. He had formed his own views on the causes of widespread malnutrition amongst Abelam children:

So you are here to look at child malnutrition are you? Well, I can tell you what the problem is....the mothers deliberately do not feed their babies. They don't want them to grow. (November 1983.)

My initial reaction to these views was to summarily reject them - an early
Plate 7-1: Mother and infant
and memorable impression of village life was the general affection for children
and their high profile in daily events. The missionary's view implied a
conscious process of child neglect, and this seemed at odds with my
observations.

Over many months of observation however, it increasingly appeared that
many aspects of Gwelikum child rearing practices were inconsistent with
optimal nurturing of infants and toddlers. Indeed, some practices seemed to
exacerbate malnutrition in these two sub-groups. A central issue here
therefore, is to determine the possible role of nurturing in the malnutrition
process. Although there are considerable cross-cultural differences in child
rearing, commonly repeated phenomena have been observed in geographically
and culturally distinctive groups (LeVine 1977) thus raising the question of
the importance of environmental influences in child nurture. If environmental
influences are important in shaping some aspects of child nurture, then the
resultant practices are assumed to have some adaptive value.

The Abelam environment has undergone substantial change in the post
war period. There have been substantial changes in the underlying processes
controlling demography; socio-cultural changes have restructured some aspects
of economic activity; and the physical resource base has changed, generally
for the worst. Some current nurturing practices appear to have evolved under
very different circumstances than presently exist, and this apparent nurturing
disequilibrium has led to the development of two hypotheses: that traditional
nurturing practices are an adaptation to conditions of high infant and
toddler mortality; the second is a corollary of the first - that such nurturing
practices are maladapted or inappropriate to contemporary demographic
processes and may be contributory factors in child malnutrition. A number
of other hypotheses are also suggested and considered: that nurturing
strategies are adaptations to the inherent food bulk-density problem faced by
infants and toddlers; that child nurturing and subsistence labour
requirements are competitors for female labour, with nurturing assuming
secondary status; and finally, cultural values, particularly feeding management in relation to developmental age and concepts of ideal body weight are inconsistent with maximizing nutritional status.

7.1 General features of infant and toddler nurture

For most mothers, childbirth, midwifery practices and cultural rules associated with birth are unaltered from the pre-contact era. Most children are born in the village. When a woman begins labor she may mention it to a close female friend, her mother or some other relative, and she usually retires to the family house (most husbands do not now object to the birth occurring in the house). In the final stages of labour she may squat over some freshly cut banana leaves. There may be general chaos amongst the attendants and the mother-to-be. At one birth attended by my wife, although the mother had been in labour for some hours and the event was well known to the hamlet's occupants, there was no preparation whatsoever. The baby was born but a sterile razor blade for cutting the umbilical cord could not be located. The woman's husband refused to lend one of his new shaving blades so an old blade was eventually used. Then it was discovered that no clean cloth was available for wrapping the infant, but after much talking, a cloth was eventually found. Most mothers breastfeed their babies soon after birth. The former practices of expressing and discarding the valuable colostrum until "real" milk is produced, and the use of wet nurses, are now rare. Mother and infant remain confined to the birth house for about five days before resuming normal activities.

The newborn infant is loosely swaddled in towelling cloth and placed in a newly made string bag known in pidgin as a bilum. For the first 6 months, when the mother is not sleeping, the baby spends most of its time in the bilum. The infant sleeps with the mother and is breastfed on demand throughout the night. During the day, when the infant cries, it is removed from the bilum and breastfed on demand. When feeding stops the infant is
returned to the *bilum* and is encouraged to go back to sleep. The mother either carries the *bilum* hanging from her head with the infant lying in the small of her back or hung from a beam, post or tree branch. If the baby cries it is either removed and breastfed again or rocked to sleep in the *bilum*. The sleeping position inside the *bilum* is rather like the foetal position and babies seem to relax very quickly once placed inside. One of my daughters (aged 30 months at the start of fieldwork) always fell asleep quickly if placed in a *bilum*.

Although the *bilum* is used throughout the first year or so as the chief child restraint and pacifier, from about 6 months of age onwards most mothers tie the child to one hip in a cloth sling. When awake, the child is either breast feeding (on demand) or simply watching surrounding events. It is very rare to see a mother, or any other person, playing with the child. There is little mother-child eye contact or vocalisation. Mother does not "shape" the physical or vocal behaviour of the child and indeed the inescapable conclusion is that the infant is virtually an extension of the mother. Parents often refer to this as the "attached to mother's skin" stage. If the child cries, the breast is immediately offered; in one year of fieldwork, I rarely saw other foods offered in these circumstances. I have often seen a mother snacking and her infant signalling an interest in sharing this food but the mother's usual response is to offer the breast to the child.

Older girls sometimes carry sibling infants in a cloth sling but although many girls are capable of helping their mothers, most do not, or assist only irregularly. Parents sometimes admonish their daughters for laziness or for refusing to assist but no child is forced to perform these tasks. Boys are rarely asked to assist in child care duties.

Most infants are not offered supplementary foods of any kind until eight months old (see also Ross 1984). Some may be offered food at five or six months but this is rare and the offerings are infrequent. The emergence of the first two deciduous teeth is regarded as an indication of an appropriate
time to start supplementary feeding but this is not a rigid rule or requirement. Two teeth have usually emerged by about 8 or 9 months. Supplementary foods are offered in very small pieces, usually fragments of mother's meal or snack. No special preparation occurs, nor is any special assistance offered (see Chapter 5). All "strong" foods are avoided, that is foods which need much chewing, including certain varieties of bananas, yams, breadfruit, coconut meat, roast sago, and animal flesh. Foods deemed suitable for infants include pawpaw, mashed sweet banana, pumpkin, sweet potato (all introduced plants) and all soups (excluding the leaves and grated coconut components).

Supplementary feeding is not a gradual, consistent process. If ripe sweet bananas, pumpkin fruits, or pawpaw are readily available, the child is usually given these foods, perhaps even daily. However, these foods are not regularly available\textsuperscript{1} to all families with under fives. Thus, an infant on an "educational diet" receives supplementary foods consistently only for as long as the family's own supply of suitable foods lasts. There is no exchange or transfer between families of foods intended specifically for infants. Infant/toddler nutritional requirements thus have no social or economic effects. This punctuated food intake pattern continues until the child begins consuming the full range of adult foods - usually at about 2 years.

After the age of 6 months or so, the typical child grows much more slowly than in its first 6 months, with the majority showing evidence of "wasting" (Chapter 4). With declining growth rates there is a discernable increase in child lethargy and diminished mother-child interactions. The malnourished child either sleeps, or if awake, is very passive and does very little other than perhaps crying. Babbling and other vocalising are rare.

After about 6 months the child generally experiences considerably more episodes of sickness than in his first 6 months (Chapter 6). Depending on

\textsuperscript{1}Irregular supply is due to: fruit fly attack in bananas; rot in pumpkin fruit; theft of pawpaws; and gaps between harvests.
the sickness, bouts of crying, periods of lethargy, anorexia or sleep may alter
the child’s normal behaviour. Mothers are concerned with any such altered
states generally, and in particular, they respond to crying. A child who
frequently cries is offered the breast more often but if this fails to reduce the
crying the mother may suspect it is ill. She may take the child to the Aupik
aid post for treatment (although treatment may not be sought or is perhaps
delayed). Lethargy or listlessness rarely elicit a maternal response unless
considerably out of character for a particular child. If the child has gradually
become listless or lethargic it is not usually perceived as a problem. The
"normal state" for children between approximately 6-24 months is one of
listlessness and lethargy.

Eventually, the child becomes more physically independent of its mother.
As the child’s gross motor skills develop, attempts are made to walk (at
about 18-20 months). Talking starts at about the same age as walking and
parents regard walking in particular, as a memorable event. A child’s first
attempts at walking are usually accompanied by a small traditional ceremony
and a song is sung calling upon the ancestor spirits to help and guide the
child throughout its life. In a sense, this is when a child is "really born" and
becomes a separate entity. It is a rite-of-passage. Feeding becomes more of a
conscious process and significantly, children begin to improve nutritionally at
about this time.

7.2 Infant and toddler nurturing behaviour as adaptation

The preceding description of general early childhood practices shares
many features with observations by LeVine (1977) of his experiences in Africa
and from the Latin American and Indonesian accounts of others. He
considered the general pattern to be a "...cultural adaptation to high infant
mortality rates" (LeVine 1977:23). The main elements of the general pattern
are:

1. The infant is on or near a caretaker’s body at all times, day
and night.
2. Crying is quickly attended to and becomes rare relative to Western infants.

3. Feeding is a very frequent response to crying.

4. There is, by Western standards, little organised concern about the infant's behavioural development and relatively little treatment of him as an emotionally responsive individual (as in eye contact, smile elicitation, or chatting) (LeVine 1977:21)

LeVine considered that there are three universal goals of parenthood. Of primary concern is the physical survival and health of the child. If this is achieved the second aim is to develop the child's ability to survive (economically) in adulthood, and thirdly, to develop...“the child's behavioural capacities for maximising other cultural values” (LeVine 1977:20). These goals are hierarchical and clearly, the first aim must be achieved before “higher level” objectives can be satisfied. LeVine hypothesised that

in populations with high infant mortality rates parents will have the physical survival and health of the child as their overriding conscious concern, particularly in the early years, and child rearing customs will reflect this priority (LeVine 1977:21).

In Western societies however, child survival can almost be guaranteed and parents are more likely to turn their attention to the development of the child's behavioural capacities at an earlier point in his life (LeVine 1977:21)

Customs have evolved to relieve parental anxiety and concern. By institutionalising or formalising child rearing customs, the psychological costs to individuals associated with “negative” practices are minimised (McKee 1984). Thus, the Westerner who observes the apparently unconcerned mother of a severely ill child in a Third World setting is frequently unable to understand the cultural adaptation which enables the mother to cope. This phenomenon of the apparently unconcerned mother has been described as the “lack of appropriate demonstration of grief” by Scheper-Hughes (1984:536). In a Western society, the cultural context of high infant morbidity and mortality is no longer present so when severe illness strikes, the cultural crutch or reference is absent and hence anxiety, fear and helplessness may be
felt. This equally explains the Westerner's attitudes toward the observed Third World mother and child and the Third World mother's attitudes.

LeVine (1977:24) theorises

that a high infant mortality rate and severely limited resources for responding to disease have shaped a folk pattern of preventative medicine in infancy that reflects parental concern for the physical survival and health of the child and is relatively efficacious in attaining that goal given the low level of medical technology.

This pattern of infant care is typical in societies of very high infant mortality (defined by LeVine as 45 percent or more births dead before 2 years of age), and is usually an ancient phenomenon having an impact on generations of parents. Because of the severe threat to infant survival in these circumstances, the general pattern of infant care represents "a constant medical alert, a chronic emergency mobilisation to save the child at risk" (LeVine 1977:25). Close contact with the child is a form of monitoring. Crying elicits an instant response by the mother who is in a position to judge the child's condition. If crying cannot be stopped through feeding, it is possible that the child is ill. Crying is thus an important signal:

...frequent feeding, particularly breastfeeding, serves to replace fluids and alleviate the dehydration from diarrhoea that is probably the most frequent precipitant of infant death in the tropics...all in all, though not a highly effective medical system, it is an adaptive response to extreme environmental hazard and probably has more efficacy than is readily apparent (LeVine 1977:25).

Higher-level parental objectives, such as ensuring development of the child's social and emotional relationships, are postponed until later, when reasonable prospects of the child's survival are evident.

The general pattern of early childhood rearing in Gwelikum is similar to that described by LeVine for many other cultural groups. In the pre-contact and early colonial period, Abelam infant and child mortality rates were extremely high (500-600/1000 live births dead before 15 months - see Peters 1960; Forge 1970), mainly from malaria (but neonatal tetanus and pneumonia were also important). Malaria has probably existed in the Maprik and other areas of Papua New Guinea for a very long period, as evidenced by the
presence of some genetic adaptations (Nurse 1985), so clearly there has also been a long period in which cultural responses to the severe biological hazards could have evolved (assuming that the Abelam or their ancestors were exposed to these hazards over a long period). There have been parallel cultural adaptations in child rearing in many unrelated and geographically distant cultural groups and I believe that the pattern observed in the general model is one derived from a cultural adaptation to severe biological stress. Prolonged breastfeeding and delayed weaning in the Usimo of Papua New Guinea is thought by Conton (1985) to be an adaptive strategy: infants and toddlers benefit through less exposure to pathogens and hence disease.

One aspect of the cultural adaptation explanation needs more consideration. If the LeVine model is a legitimate explanation for an often observed phenomenon, why do the Abelam fail to systematically and adequately feed (other than breastmilk) their children during this critical infant and toddler period? This is considered more fully in the second hypothesis below and the Lepowsky (1985) hypothesis (see below), but if pre-contact infant mortality rates and the absence of health care can be imagined, a clue probably lies in the answer to this question: what is the advantage of attempting to maximise the nutritional status of the high risk age group if more than half will die anyway before the age of 15 months? The withholding of food will mean that the group as a whole will be sub-optimally nourished and therefore predisposed to higher morbidity and mortality but as this strategy may accelerate infant wastage, it allows parents to maximise the nurturing of fewer survivors. The task becomes easier in the sense that a high mortality rate ensures that there are fewer infant and toddler consumers. Parents (particularly mothers) can devote more energy towards ensuring the continuing survival of the survivors and the so-called “higher level” ambitions for those children. Peters (1960) observed that on average, in pre-medical intervention circumstances, there were only 1.3 living children to every Abelam woman of child bearing age, thus
confirming the lower consumer:producer ratio that formerly existed. There
were no choices: fertility was high, with an average number of births per
woman (of completed reproductive life) for the period of 1945-60 of 5.27
(Gorlin 1973). With such a high birth rate, a correspondingly high infant
mortality rate was required for parents to adequately maximise the potential
of their children. Fertility was high despite sexual prohibitions practised as
an integral part of ceremonial yam cultivation. It does not seem likely that
widespread infanticide was practised purely as a means of population control
(contra some Upper Sepik groups: see Townsend 1980) but deformed and very
sickly neonatal infants were killed or allowed to die.

Scheper-Hughes (1984) takes issue with child rearing explanations which
focus on "...the largely impersonal ecological, climatic or demographic
conditions..." of many less developed countries. She considered that
they [the researchers] have also largely neglected the micro-
perspective, the extent to which psychocultural factors come into
play as Third World women, mothers and workers, may be cast in
the role of family strategists...ethnoeugenic [selective neglect]
childrearing strategies that prejudice the life chances of those
offspring judged "less fit" for survival under the pernicious conditions
of life... (Scheper-Hughes 1984:535)

The "selective neglect" hypothesis suggested by Scheper-Hughes (1984)
considers that the mothers themselves may have suffered a kind of "selective
neglect" in that they have been excluded from economic activity (ie., they
are marginal). Although Scheper-Hughes specifically focussed on child rearing
practices in explaining high infant mortality, the hypothesis is relevant also
to the closely related issue of child rearing in explaining malnutrition.

I submit that the Abelam nurturing model is not "selective neglect" but
"general neglect". The Scheper-Hughes "selective neglect" hypothesis seems to
be a phenomenon which arises from more recent social, cultural or economic
upheaval (eg., arising from large-scale rural-urban migration). The LeVine
(1977) hypothesis sees a dominant nurturing paradigm emerging as a result of
long-standing evolutionary pressure. Cassidy (1980) argues that the type of
nurturing described by LeVine and proposed in this thesis is a kind of
"culturally sanctioned benign neglect" which benefits the group or population as a whole but which disadvantages the individual child. Such "benign neglect" is not perceived or consciously understood by individuals (cf. missionary's quotation above) - if it were, it would be rejected as inhumane by most parents. The strategy is thus institutionalised within the culture, and removes some of the responsibility from individuals.

The above discussion has emphasised the importance of a "culture of nurture" as an adaptation to high infant and toddler mortality, and its functional importance to the family by minimising energy expenditure in child nurture. Lepowsky (1985) however, raises the possibility that many such nurturing practices (especially those involving the restriction of protein-rich and iron-rich foods), may benefit the individual child. Her hypothesis is thus fundamentally different from the emphasis of the preceding discussion, that is, that the benefits of the "culture of nurture" accrue to the general population, and may actually disadvantage the individual child. Lepowsky (1985:120) suggested that

The reported prevalence of mild and moderate undernutrition which may result from this practice may be a trade-off for increased resistance to potentially lethal and debilitating malaria attacks.

A number of studies have suggested a link between a deficiency in a range of nutrients (protein, iron, and various vitamins), but particularly iron and protein, and susceptibility to malaria (Scrimshaw et al 1968; Murray et al 1978; Murray et al 1978; Etkin and Ross 1983). Lepowsky hypothesised for a lowlands Papua New Guinea population that...

...the evolution of populations adapted [as evidenced by the work of Ferro-Luzzi et al 1975, 1978; Macpherson 1963; Norga et al 1974; Oomen and Corden 1970.] to low-protein diets came about not only because of the relative scarcity of animal protein foods away from the coast but because such a diet offers more protection against malaria and perhaps other parasites. Childhood food taboos on animal protein consumption may have evolved concurrently with a biological adaptation to low-protein diets for the same reason. Similar taboos may have evolved as a cultural adaptation in other malaria endemic areas of the world (Lepowsky 1985:121).

If the malaria susceptibility-nutrient deficiency relationship is biologically
demonstrable and a general phenomenon, Lepowsky's hypothesis may have wider significance. Although the Lepowsky hypothesis and the LeVine hypothesis differ in opinion as to the losers and beneficiaries of the nurturing paradigm, the two are complementary if interpreted in sequence, beginning with the LeVine hypothesis. The "adaptation to mortality" hypothesis (i.e., LeVine) facilitates infant wastage due to disease (chiefly malaria) and is thus an energy conservation process within the family economic unit. The "adaptation to morbidity" hypothesis (i.e., Lepowsky), in a sense, is both energy (and protein) saving through directing scarce vital food resources to others, and one of assisting in maximising the survival potential of the remaining infant or toddler.

There are two difficulties in applying Lepowsky's hypothesis to the circumstances observed in Gwelikum. The first is that anaemia in under fives appears to be due to chronic malaria parasite infection. If low haemoglobin levels are truly an adaptation to malaria then malaria parasites seem to have both created the low haemoglobin levels and in doing so, made their own ecological conditions less favourable for their own perpetuation. Gwelikum under fives are both anaemic and heavily parasitised by *Plasmodium falciparum*. I am not convinced that the claimed adaptive value of anaemia is the result of dietary deprivation, although it may be. Much more work is certainly warranted on this issue. The second is that infant mortality rates were so high (see below) that the pressures for a "culture of nurture" to evolve as an adaptation to morbidity may have been weaker formerly, than they appear to be now. Notwithstanding these qualifications, the two hypotheses together provide a strong explanatory tool for understanding the very high rates of malnutrition in under fives in conditions of apparent food adequacy.
7.3 Infant and toddler nurturing behaviour as maladaptation

In the previous section, I emphasised traditional nurturing practices as an adaptation to high mortality rates in infants and toddlers. The Lepowsky (1985) hypothesis has some value in understanding an Abelam "culture of nurture", but I believe it to be less important than the "adaptation to mortality" hypothesis. In this section, I argue that in the contemporary village, the traditional nurturing pattern still practised is maladapted to the high rates of child malnutrition which exist today, and indeed may even be a causative factor. The indirect evidence from a number of sources suggests that although undernutrition may have existed formerly, it is now a more significant problem (Chapter 6). This can be traced to changes in mortality leading to altered survival potential and the emergence of a new family demographic profile - all of which have produced conditions not capable of adequate response by the traditional "culture of nurture".

The hypothesis discussed here is a corollary of the first hypothesis, which argues that the traditional nurturing process was an adaptation to high infant mortality rates. Infant and toddler mortality has declined and although there is incomplete knowledge concerning how morbidity patterns have changed since colonisation, the general morbidity regime appears relatively unchanged from pre-intervention conditions (Chapter 6).

The traditional nurturing strategy evolved in circumstances where exposure to disease eliminated the most malnourished children. Thus, a traditional concept of malnutrition (and implicitly a strategy to deal with it) was inappropriate. Such a concept must arise when the phenomenon is both real and has real consequences which are capable of being managed or responded to. Formerly, there was no perception of such a "problem" - it was effectively dealt with by high mortality. Rather, a response strategy (i.e., LeVine's model) developed in the face of unmanageable natural hazards, but also prevented the emergence of a concept of malnutrition.

The concept of malnutrition exists today but not as a fully developed,
conscious notion; rather, its significance is highly variable within the village. For most, the concept is recognised, but has little meaning and impact. Of course, a severely wasted child is identified as being sick but such severe cases of clinical malnutrition are rare in Gwelikum. The term *apangrelbandi* means "very thin child" but the term is not widely used and if the subject of malnutrition arises, the equivalent pidgin terms "bun nating" or "sik bun" (emaciated; only skin and bones) are used. During fieldwork I saw two clearly emaciated children but one had become so very quickly as a result of severe diarrhoea, whereas the other child had slowly and uneventfully reached much the same state. Most villagers regarded the first child as "sick" and in need of medical treatment, whereas the second child was not regarded as a problem at all. Since very few children achieve full Harvard growth standards, the normal child is usually slightly malnourished. A toddler who is at 100 percent or higher of weight and length standards seems incongruous in the Gwelikum setting.

To some extent, the MCH nurses' view that it is a wasted effort telling the mothers that their children are malnourished is understandable. Indeed, some nurses do not believe that there is a problem despite their academic training. When a mother is told by a nurse or other health workers that her child is inadequately nourished the mother usually ignores these comments. Within the village hearth setting an elderly woman might occasionally take the initiative and feed her grandchild. I saw this on a number of occasions and is puzzling when compared with the usual contemporary maternal behaviour.

Although there has been a cultural change in the response to illness in children through the general acceptance of Western health facilities, there has not been a corresponding general cultural change towards the recognition of malnutrition, and altered child nurturing practices. Some exceptions are discussed below (section 7-7). The contemporary mother simply does not know how to respond to the "new child" and its problems. In the past, very high infant and toddler mortality pre-empted this potential problem.
7.4 Nurturing and the food "bulk density" problem

Toddlers face the seemingly insuperable problem of their inability to eat enough of the common high-bulk, low-density foods to maintain adequate body maintenance and growth. This inherent problem is compounded by very high sickness rates which interfere with appetite and hence regularity of dietary intake (Chapter 5).

It is possible that the child nurturing system recognises the insuperable bulk-density food problem in toddlers where conditions of high morbidity exist. If the problem is recognised, and culturally perceived as insuperable, then the optimal strategy in terms of energy conservation (ie., to benefit the family unit), is to delay maximal nurturing input until the highest mortality risk period has passed. At about this age (24-30 months), the capacity to eat more of the bulky diet begins to improve, and the gap between dietary needs and capacity to consume narrows. Thus, the "culture of nurture" is equally a response to the inadequate, inappropriate food resource as it is to high mortality (and perhaps morbidity) risk.

7.5 Subsistence agriculture and child nurture: a conflict of interests?

The "adaptation to mortality" and "food bulk density" hypotheses discussed above are only partial explanations for the group of nurturing phenomena described by LeVine (1977). High infant mortality has resulted in the evolution of a repeatedly observed, recognisable child rearing strategy in diverse cultural groups. These cultural groups also have similar approaches to economic activity. The patterns described by LeVine are typically found in simple technology, horticultural subsistence systems. Is it possible that labour demands, and in particular subsistence labour demands on women, are important factors which have shaped the evolution of a distinctive "culture of nurture"? The hypothesis presented here is not an alternative to the above hypotheses but argues that other factors in addition to high rates of infant mortality have given rise to "cultures of nurture" similar to that observed in the village.
Before evaluating the hypothesis, I describe the meaning of subsistence agriculture for the individual family through an account of a typical day in a family comprising Wooranamini (household head), Gwalimbus (his wife), sons Ramu, Wingu, and Christopher, and daughters Salinjo, (with infant) and Yuangen.

Today is typical (i.e., the MCH clinic or Cocoa buyer is not expected, there is no business in Maprik and it is not Court or Council day), and the family intends going to its food garden. After half an hour of little activity in the family group after rising (6.15 AM), Gwalimbus roasts the morning meal of yams, turning them occasionally with cane tongs to ensure even cooking. As usual, one type of food is eaten, but the species varies seasonally. At 16 months, Christopher is not yet able to walk, and while Gwalimbus is cooking, she is breastfeeding him. Salinjo is an unmarried 18 year old with an 8 months old daughter, Sophia, of unknown paternity. Sophia receives no supplementary feeding whatsoever and is described in her MCH clinic book as being "severely malnourished". Sophia has high fever (malaria) and is frequently crying. Wooranamini insists that the child be taken to the Aid Post for treatment.

The family eats the yams fairly quickly (breakfast at the hamlet is not regarded as a "serious" meal and many families do not bother to eat until they reach the garden), and Gwalimbus commences the usual pattern of cleaning up the meal scraps, dousing the cooking fire and smouldering logs, gathering the saucepans, various bilums for carrying Christopher and garden produce, and her bush knife. Wooranamini is sitting with two older big-men, drying tobacco over a makeshift fire as they discuss various aspects of ceremonial yam cultivation.

By about 9.30 AM the family is ready to lock its house and walk to this year’s main subsistence garden some 40 minutes from home. The family has not visited this garden for some weeks and today will be the start of intensive weeding in readiness for yam harvesting in about a month’s time. Gwalimbus decides that Christopher will be carried in a cloth sling at her side as her large bilum, carried on her head and full of cooking equipment, takes up too much room on her back for Christopher to ride in his own bilum. Wooranamini is about 5 minutes behind the rest of the family, his delay due to the extended discussions with the two older big-men. He carries his bush-knife and a small bilum containing betel nut, lime and tobacco.

The bush trail to the garden traverses highly variable topography. Wooranamini’s hamlet (Baingrin), is on a ridge. The trail immediately descends a very slippery slope, at the base of which passes a creek. The family fords the creek upstream from the large waterhole where Wooranamini’s clan waale resides. They ascend another slippery slope then enter the hamlet of Illamungei. Past Illamungei is the now deserted hamlet of Wirapu, the largest hamlet at the time of first contact with Europeans and the scene of much ceremonial activity in pre-contact times. After the dysentery epidemic of World War Two, the hamlet was abandoned. The trail is relatively flat here but a number of fallen trees force some clambering and detouring through thick undergrowth.
Three more hamlets are bypassed and the family now journeys along a rarely used trail which is being reclaimed by various grasses and tree seedlings. Gwalimbus prods and slashes at the grass in advance as there is the ever present fear of treading on a snake or centipede. The latter is feared because of the acute pain which may last for up to 2 days. Snakes are common in the area but are quick to avoid humans and are rarely encountered if care is taken. The family reaches its yam house at Wooranamini's brother's hamlet of Siknaangmingi and briefly pauses to exchange pleasantries.

The final stage of the journey takes the family through a cluster of last year's gardens in various stages of re-use or reclamation by the forest. Gwalimbus has stepped on an obscured cluster of yam thorns carelessly thrown away by last year's gardener at harvest time. One thorn has penetrated her heel and she is in considerable pain. She stops and removes most of the thorn then continues down the last part of the trail. Shoes are not usually worn as they lead to fungal disorders, are unstable on slippery, steep slopes and quickly rot in the wet, tropical conditions. One last hazard must be dealt with. At the base of this slope is a large stand of spiny sago palms, which signals that extreme care should be taken. The sharp spines are up to 6 cm. long and are notorious for breaking off after penetrating the skin, leaving a section which leads to a painful, swollen foot or hand. The creek is flooded, and the family must negotiate a new path through the palms and their debris. Luckily on this occasion, the new path presents no problems. Finally, the family arrives at its garden and immediately deposits its possessions in the garden house (an open-ended shelter). Christopher is breastfed then placed in a *bilum* and carried about by Gwalimbus until he falls asleep. Ramu, Wingu and Yuangen have disappeared into a patch of adjacent, older forest regrowth to look for bird's eggs.

In a stooped manner, Gwalimbus starts weeding with her bush knife. Her legs are straight and her back bent forwards at about 45 degrees. She faces uphill (the garden has an 18 degree slope) so that she does not have to stoop too far. Christopher is still awake but is quiet in the *bilum* on her back as she works. After 15 minutes or so she hangs the *bilum* in the garden house where by this stage Wooranamini has arrived and is sitting, rolling a cigarette. Before joining his wife in work, he quickly surveys his 6 blocks, checking on the progress of his yams and other crops. The upper slopes have not produced good tubers as the vines have prematurely dried and never developed extensive leaf growth, but some of the *asaakwu* yams planted near the creek appear to be reasonable.

After about an hour's work, Gwalimbus harvests two taro plants, removes 4 sweet potato tubers and collects some fresh *Abelmoschus manihot* leaves. At about noon she lights a fire near the garden house and fills a large saucepan from a recently made soak just above the creek. The unpeeled tubers and greens cook while Gwalimbus breastfeeds the now awake Chris. At about 12.30, Wooranamini and the children converge on the garden house and start to eat the boiled tubers and greens. They eat from a single pile placed on a banana leaf. The would-be hunters were unsuccessful, but know of a Kingfisher's nest further away which they will raid in the afternoon.

Every family member eats some of the food although Christopher, because of poorer dexterity, eats a portion of sweet potato only, and does so with his fingers. He dislikes *Abelmoschus manihot* anyway
because Gwalimbus never dices the leaves and often carelessly cooks some more fibrous stems as well. After eating, work recommences, and Gwalimbus starts by soaking the saucepans and plates in the nearby creek. They will be collected later in the day. Christopher does not want to sleep and refuses to go into the *bilum*. His mother places him at her feet but must continuously check his movements because of the fear of injury on yam spines (at the base of each vine stem) or falling down the slope. Gwalimbus is not impressed by his attempts at hindering her progress and his demands for the breast. By mid-afternoon he is ready for a short sleep and is placed in the *bilum*.

At about 4.30 PM the family is ready to return home but first, Gwalimbus must gather more *Abelmoschus manihot* and sweet potato for part of the evening meal. En route, firewood must also be collected. Wooranamini decides that he needs a new fire-log and knows of a partially rotted (all firewood is allowed to partially decay before use) log on his own land near the trail home. His log weighs about 50 kilograms and he walks ahead of the others. Gwalimbus, her laden *bilum* and Chris riding on her shoulders, walks slowly along the trail. The other children have taken another route home after having caught, cooked and eaten their fledgling Kingfishers in the bush. At Baingrin, Wooranamini finds Salinjo and Sophia who is still running a fever. Salinjo halted her visit to the Aid Post that morning and instead went to a friend's house. She did not meet with her family at the garden and had not collected any *Gnetum gnemon* leaves for the sago meal planned for this evening. Both Wooranamini and Gwalimbus remonstrated with Salinjo but she merely ignored their protestations.

At dusk, Gwalimbus started preparing two meals: boiled sweet potato with *Abelmoschus manihot* and sago soup with *Gnetum gnemon* (collected by Gwalimbus). The meals were eaten over a two hour period but by 7.00 PM Christopher was asleep, having eaten only a small portion of sweet potato and had several short sessions at the breast. Some soup was given to three male clan visitors, meaning no leftovers for next morning. By 11.00 PM, the whole family had retired to their houses (Wooranamini, Gwalimbus and Christopher to their ground house and the others to an adjacent elevated house).

Several points emerge from the above example. A number of hazards confront some villagers but all small children face these hazards in the hamlet, along the bush tracks, in the creeks, and in the garden. At the garden, the infant or toddler's mother must manage to efficiently perform garden tasks and care for her child. Older children are infrequently called upon to assist in child care duties. The example once again illustrates some of the uncertainties of toddler dietary intake. In addition, because of child care constraints, mothers are less able to gather wild foods from the forest - a mother with an infant or toddler is thus more likely to be nutritionally restricted to garden-derived foods.
The mother's behaviour in the above example was typical of that observed in the village. Her child was managed through restriction of activity - virtually a necessity given the hazards, the lack of child care assistance, and subsistence work demands.

The observed patterns of gross motor development (GMD) in village infants and toddlers are consistent with child management practices - so consistent that there is a possibility that GMD may be shaped (and delayed) by these practices, particularly the constant restraining and confinement of infants and toddlers. The marked GMD differences between my own and Gwelikum children led me to the collection of GMD data, and although a complete explanation for the patterns is outside the scope\(^2\) of this thesis, I suggest that both malnutrition and child management practices are important explanatory components.

The GMD data (Table 7-1) are scanty, but do not include guessed sitting, crawling, and walking ages. Nevertheless, when these data are compared with commonly used guidelines for assessing GMD (Tables 7-2 & 7-3), it is apparent that Gwelikum children differ in ages of attainment of some milestones. It should be stressed that because of the small sample size and lack of formal training in the assessment of GMD, further data should be obtained to fully investigate the reasons for divergence from the GMD guidelines.

The GMD guidelines suggest that crawling (in whatever form) can be expected to fall within the age range of 7-15 months, and by 15 months most can walk alone. By 18 months most children can walk well. In Gwelikum, in September 1984, the mean age of children unable to sit was 6.1 mths with some as old as 9 months. The GMD assessment guidelines suggest that by 6 months most children can be expected to be able to sit with some support and by 7 months start crawling. I have no firm field data on age of commencement of crawling but as at September 1984, those children who

\(^2\)Genetic factors would be difficult, if not impossible to assess.
### Table 7-1: Gross Motor Milestones, as at September 1984, Gwelikum 1&2 Combined.

<table>
<thead>
<tr>
<th>Details</th>
<th>Mean Age in mths. (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children not yet sitting (n=7)</td>
<td>6.1 (1.7)</td>
</tr>
<tr>
<td>Children able to sit only (n=5)</td>
<td>11.8 (3.5)</td>
</tr>
<tr>
<td>Children able to sit and crawl (n=8)</td>
<td>16.5 (2.4)</td>
</tr>
<tr>
<td>Age at walking (n=16) (1)</td>
<td>20.4 (4.5)</td>
</tr>
</tbody>
</table>

(1) These data not cross-sectional. Walking ages noted over fieldwork period.
### Table 7-2: Guidelines for assessing Gross Motor Development.

<table>
<thead>
<tr>
<th>Age in months</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Sits with support</td>
</tr>
<tr>
<td>9</td>
<td>Sits alone; begins crawling from 7 mths</td>
</tr>
<tr>
<td>12</td>
<td>Sits well; crawls on hands and knees or shuffles on buttocks or bear walks rapidly about the floor; walks around furniture; may stand alone</td>
</tr>
<tr>
<td>15</td>
<td>Walks alone (usually)</td>
</tr>
<tr>
<td>18</td>
<td>Walks well with feet only slightly apart</td>
</tr>
<tr>
<td>24</td>
<td>Runs, starting/Stopping with ease</td>
</tr>
</tbody>
</table>

**Source:** South Australian Child, Adolescent and Family Health Services (CAFHS). Guidelines for assessing gross motor development. (n.d; abridged)
Table 7-3: Guidelines for further investigation

<table>
<thead>
<tr>
<th>Age in mths</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>9-10</td>
<td>Unable to sit alone on a firm surface</td>
</tr>
<tr>
<td>18</td>
<td>Unable to walk alone</td>
</tr>
</tbody>
</table>

Source: as for Table 7-2.

could sit but not yet crawl had a mean age of 11.8 mths with a range of 8 to 18 months. The mean age of mobility commencement is about 12 months or older (I suspect 12-13 mths). I have firmer data on age of first walking (ie., first unaided walking) which is 20.4 months. Thus, Gwelikum children appear to differ noticeably from the pattern expected in Australian and other Western children. They remain as immobile infants for longer, sit without being able to crawl for longer, crawl later but for approximately the same length of time, and walk considerably later than is usual for Western children.

Although it is not possible to assess the individual roles of nutrition, genetic, and other environmental factors producing the observed GMD pattern, after considerable observation of mother-child relationships, I believe that the labour requirements of subsistence work have resulted in a pattern of early childhood management which ensures that child mobility and physical development is delayed until there is commensurate intellectual growth, thus minimising hazards to the child. Gwelikum infants are either "part of their mother's skin" or effectively swaddled in a *bilum* for most of the time until they can walk. They are virtually never placed on the ground - a child who can sit rarely does so, and a child capable of crawling is rarely observed doing so. Indeed the final act of walking which seems to occur quite suddenly is almost the triumph of sheer developmental readiness and need over continual constraining and checking by mother. Hogbin (1943:301) described similar behaviour in the Wogeo people from the Schouten Islands off the Sepik coast:
The Wogeo baby is not allowed to crawl and is discouraged from walking until it is nearly two years old. The natives feel that it ought to be capable of taking care of itself before it begins to move about freely. The precaution is explained by anxiety lest it should wander away unobserved and come to some harm. As soon as it shows the slightest wish to go down on all fours it is therefore either picked up or else put firmly in a corner.

The Abelam pattern differs from the observations of Conton (1985:48) who reported that Usimo (a PNG culture group) mothers consider that "the sooner a child can walk, the better" as it gives the mother greater freedom and mobility. In other respects however, the Usimo general pattern of subsistence economy and infant nurture resembles the Gwelikum pattern.

In many Western societies, early sitting, crawling, walking and talking in children are desirable traits and much physical and intellectual stimulation of infants occurs, partly because it is valued as a kind of developmental boost. In Australia, for example, many children walk before they reach their first birthday; these children tend to be highly curious about their environments and there are few houses with such children which have not been toddler-proofed in some way. If similar developmental investments were made by Abelam mothers, they would have counter-productive results. Imagine a 7 month old child crawling and exploring in a hamlet or garden, and at 1 year walking about in this environment. The hamlet is a hazardous environment for a mobile infant or toddler whose reasoning powers as yet do not match their physical development. There is increased exposure to pathogens (this supports the LeVine model), sharp objects and domestic pigs and dogs who do not tolerate being interfered with. The garden is also a hazardous place as are the numerous trails connecting hamlets and gardens. Sharp sticks, centipedes, ants, pathogens, toxic and irritant plants, snakes, yam spines, hot coals, saucepans full of boiling liquids, unsheathed bush knives and axes, topography (all food gardens are on moderate to steep slopes) are the everyday problems that such a mobile infant or toddler would encounter.

A Gwelikum mother could not afford to efficiently perform her work
and provide developmental input to her infant - the two are mutually exclusive in the subsistence world. Overall, labour is reasonably evenly shared between the sexes although there is a marked tendency for men to do more of the short-term strength demanding tasks and women the more repetitive, time consuming duties. Formerly, the more repetitive work, especially the clearing of undergrowth and weeding with stone tools, would have been more labour demanding than at present. This labour specialisation pattern is reflected in coffee processing, but to a lesser extent than in subsistence garden work. The Abelam have evolved what appears to be the only reasonable strategy available to them. Their children are constrained for most of the first 18 months of life and by the time they start walking they can usually talk a little and certainly can be warned by their parents to avoid certain dangers, objects or places.

A further major factor is involved in the developmental pattern described above. I have referred to the lethargy and listlessness which is associated with the onset of nutritional stress from about 6 months of age. A child who is lethargic and listless for some of the time is clearly easier to manage if the guardian is otherwise busy, than a toddler of boundless energy who wants freedom to explore. Thus, in a sense the apparent parenting adaptation to high infant mortality rates is also of benefit in that it permits higher labour efficiency on the part of the mother. The obvious cost associated with this benefit is that the mother must carry the child about. This is perhaps not as bad as it seems as the children are inevitably lighter than their Western counterparts and do not squirm about as much.

The pattern observed in Gwelikum is certainly not universal in Sepik societies. Weiss (in press) commented that "Tatmul mothers could not be providers for their families unless older children (8-18 years) look after siblings, especially infants". I have commented on the minor role of older siblings in the care of infants. A time allocation analysis in an Abelam community established the relatively minor role of infant/toddler care by
siblings (Scaglion, in press). The Iatmul and Abelam strategies seem to achieve the same objective: to permit the woman to work efficiently as subsistence providers. The pathways to this end differ however: Abelam mothers retard infant GMD and immobilise their infants; Iatmul mothers make greater use of older children as infant caretakers. Unfortunately, Weiss did not explain how first-time Iatmul mothers are able to work efficiently - perhaps they do not.

The Abelam and Iatmul approaches are just two types of child rearing. Infant care methods vary in different subsistence systems in the way that they permit women to maximise labour efficiency. Katz (1984:338) identified four basic patterns.

...!Kung San foraging mothers carry their infants with them while gathering wild foods from the bush, and thus maintain prolonged breastfeeding and physical contact with the infant (Konner 1977) [the first pattern]...East African mothers' farming work requires them to be separated earlier from their infants and to rely on child nurses and the early introduction of supplementary foods (LeVine and LeVine 1963) [the second pattern]...other areas of the Pacific...where women are primarily horticulturalists...mothers carry infants to the garden but have it [sic] tended there by other family members (Akin 1983; Conton 1985; Gregeo and Watson-Gregeo 1983) [the third pattern]...and in the outer Fiji islands...some of a woman's subsistence work cannot be performed while carrying an infant, but social mechanisms exist to allow her to be excused from this work and to remain with the infant during a nursing period of more than a year [the fourth pattern].

The Abelam pattern differs from all of the patterns described by Katz (1984) and Weiss (in press). It has some similarities with the first and third patterns, but the role of child caretakers (in the Abelam) is much less important, with maternal control over infant mobility through physical constraint more significant. The Iatmul and outer Fiji islands infant nurture systems, which utilise caretakers to a greater degree than Abelam mothers, may have evolved because of absolute need arising from fishing as part of their subsistence economies. It may be that certain subsistence activities demand mother-infant separation and the development of an alternative infant management system.
Thus, the Abelam pattern represents a fifth distinctive nurture-subsistence system, and although it has obvious costs - particularly to the child through delayed motor development and hence nutritional well-being; and to the mother who must both care for the child and perform regular subsistence tasks - the pattern is consistent with the hypothesised processes underlying an Abelam "culture of nurture".

7.6 Delayed development and delayed weaning - the possibility of a vicious cycle

I have briefly discussed the issue of the delayed introduction of weaning foods in the context of the "adaptation to mortality" hypothesis but it requires evaluation here also. One feature of the commencement and progressive introduction of foods to children is that the decision to start is determined by the developmental rather than the chronological age of the child. This means that a malnourished child, who tends to be more lethargic, listless and perhaps slower in GMD than a well nourished child, will not be offered certain foods (or perhaps any) because the child has not reached the "appropriate" level of development (see Jenkins et al 1984). Thus a vicious cycle develops and the malnourished are disadvantaged by extended food deprivation. Two case studies may assist in understanding the "vicious cycle" hypothesis.

Wopingien's last born child was Kalson, a boy. She had three other children. Yawei has had four children but only two survive. The last born was Adrian, also a boy. Their anthropometric details are shown in Table 7-4. At six months Adrian was not yet sitting, and Kalson, at 16 months, could crawl around on his buttocks. He started doing this at 14 months. In the previous 3 months Kalson had been ill with severe diarrhoea and had not gained weight. He had been hospitalised but Wopingien absconded with her child after one day in hospital. Kalson was a very listless, sick-looking child and merely clung to his mother's side with his head resting on her breast.
Table 7-4: A Comparison of two children, September 1984

<table>
<thead>
<tr>
<th>Name</th>
<th>Birth date (age)</th>
<th>WGT Kg</th>
<th>W/A %</th>
<th>HGT Cm</th>
<th>H/A %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrian</td>
<td>5.3.84 (6 mths)</td>
<td>7.3</td>
<td>106</td>
<td>66.5</td>
<td>101</td>
</tr>
<tr>
<td>Kalson</td>
<td>19.4.83 (17 mths)</td>
<td>7.6</td>
<td>70</td>
<td>73.7</td>
<td>92</td>
</tr>
</tbody>
</table>

In a sense, he differed little from Adrian because both mothers carried their sons about in a sling, neither child could talk, and both received much the same low level of stimulation. The two mothers, and the others in the hamlet did not really distinguish between the two children. It did not matter that nearly a year separated them and that for all of the chronological difference in age, there was not much difference in their weights. Both were just *munyakabandi* ("a child who drinks milk only"). An older *munyakabandi* usually receives additional foods but will receive more, and more frequently if it is less of an infant and more of a sentient, separate entity.

Kalson was a true *munyakabandi* for a long period as he could not crawl until 14 months and was unfortunate in being ill with diarrhoea for a significant period (41 treatment days between between 12-17 months). His relatively slow GMD appeared directly linked to his illness which transformed him into a very listless, apathetic child. He was always well below 100 percent weight-for-age and so entered the critical growth and morbidity risk period (> 6 months) as a small child. Over one year, I observed Wopingien managing Kalson on the basis of his apparent developmental age, and accordingly he suffered for it. Should he\(^3\) survive to reach the *batnyrapbandi* stage ("standing, falling down phase"), he will become a different person in terms of family perceptions. By the time he reaches the *pitipityabandi* stage ("child who walks well") he will also be able to speak a little and he will be an acknowledged member of the hearth.

\(^3\) I left the village just as he was ready to enter this stage.
Although Adrian entered his second six months of life with favourable W/A and H/A indices, his increasing weight was the subject of conflict between his mother and the MCH nurses. Adrian had been fed sago and yam soups but only infrequently. The MCH nurses encouraged Yawei to introduce a wider range of foods and provide them more often. Yawei had attended school to year six and understood the nutritional and growth implications of proper weaning practices. Her husband, Gukwali, was an unschooled but intelligent man with many years residence at Madang. His rational view was consistent with that of his wife and the MCH nurses. Both parents, however, practised the more usual Abelam method of weaning. Gukwali's unsolicited comments one evening came as something of a revelation to me. Our discussion originally focussed on plans to build a new MCH clinic as the nurses had threatened to exclude Gwelikum from their monthly circuit unless the dilapidated clinic building was replaced. Gukwali considered the MCH nurses to be of somewhat limited value and was especially critical of their nutritional advice. He simply said

If you follow the MCH nurses' advice, babies will grow too big. A big baby is no good - they are too heavy and a nuisance having to watch them all the time and carry them about.

Gukwali's comments, and the independent ones of another parent some days later clearly point to the value of low body weight as an Abelam growth ideal in children and the resistance to the ideal of higher body weight. It also hints at passivity (lethargy?) as a desirable infant/toddler trait. These articulated views confirmed my numerous observations which until then only indicated low body weight to be an Abelam cultural ideal. This finding has also been documented by Montague (1984) for a Trobriand Islands culture group.

Relatively low level technology and the absence of inputs permitting higher productivity in the subsistence system has meant that a system of early childhood management has evolved which effectively retards the physical development of the child until its intellectual development is in alignment.
This system assists in maintaining and maximising female labour productivity. The concept of structuring nurture practices in accordance with developmental age rather than on the basis of biological needs or chronological age compounds the problem of undernutrition in the already malnourished child.

7.7 Towards a new "culture of nurture"

A considerable part of the preceding discussion focused on two main issues: the adaptive value of the traditional nurturing paradigm to pre-contact demographic and subsistence dynamics; and how this system of child nurturing is maladapted to significantly altered present day demographic processes. Indeed, the extension of former nurturing practices into the present may be contributing to malnutrition in the under fives.

Notwithstanding the general pessimism of the above discussion, I believe that there is evidence of positive change in some nurturing practices. In general, these changes seem to be associated with families who have positively responded to Gwelikum's increased interaction with various externalities such as the MCH clinic and the Women's Club. In short, the families and the externalities are symbols of modernisation, a process which has altered the perception of the infant and toddler and hence its place in the family.

Neither the MCH clinic nor the Women's Club have been generally successful in altering Gwelikum child feeding and management practices, although their impact is obvious in some examples. During the monthly MCH clinic visits to Gwelikum, children are treated in the order in which their mothers submit their clinic books. Once their children have been examined and treated, most mothers return to their village hamlets or to their gardens. A small group of women however, attentively congregate near the MCH nurses as they work. They make unsolicited comments or occasional interjections, including ridicule, expressions of comfort, or provision of extra information. This small group leaves last, having actively participated in the morning's proceedings. Their children are better nourished,
are cleaner, and have fewer sores, scabies and fungal infections than average. The women concerned are very careful not to appear authoritarian nor do they offer advice more frequently back in the village. Although there is a strong tendency for all people to conform to a fairly standard set of social and cultural mores, few Abelam will readily submit to the direction of another. In the case of external authority, most Abelam will follow directions but only for a limited period, possibly because it creates a feeling of powerlessness.

The MCH nurses tend to be very confident, relatively well educated, and clearly relish their "escape" from the home village (see Reid 1984). During a year of contact with the MCH team visiting Gwelikum, I found most nurses to be intimidatory. They tended to ridicule, and generally regarded village mothers as stupid (see also Conton 1985). The nurses were more interested in the correct recording of statistics at each clinic than in the consultations. The average examination and dialogue with the child's mother lasted for about one minute. The real time spent examining children was a small proportion of a morning's work. Village mothers responded to the nurses' attitudes in a number of ways. Many were terrified of the nurses, trembled, and were so inhibited that they were sometimes unable to speak; others ignored the nurses, and a minority (such as the "small group") were confident in their relationship with them. Thus, the MCH clinic is clearly of limited value to contemporary mothers learning to respond to the problems of the "new child" such as malnutrition. Nevertheless, there are signs that some villagers are slowly adapting to the now significant problems of malnutrition - and in the long term, because of the conformist tendencies, there may be a general shift in the "cultural paradigm" and the aberrant child nurture component of child malnutrition will be erased.

The Gwelikum Women's Club was rather like the MCH Clinic in its effectiveness in coping with the problems of child malnutrition. The club (one of a provincial network formed under the auspices of the East Sepik Council
of Women (ESCW)), was originally conceived of as a method for women to exercise some control over economic development and the health and physical well-being of people within their own village. Many development topics were planned for village women. Nutritious cooking, the development of kitchen gardens, hygiene, infant weaning, sewing, and small business skills were all part of the ESCW's training objectives. The club initially attracted many members, and elected officials were trained in many of the above matters. Most Gwelikum men were enthusiastic and one man allocated a sizeable plot of land for the club complex, piggery, and kitchen garden. Over time, the club became moribund, and members acted mainly as a source of cheap group labour for coffee garden work. Many men complained that the club was over-taxing their wives and that their families were being neglected. Many women were intimidated by their men into leaving the club. Some men cynically formed a "men's club" - in reality, a tavern. The remaining club members were the "small group" (above), precisely the women that the club did not need to reach - their target women were sadly disenchanted and had withdrawn their support. One of the final club activities before I left was the sale of the club's remaining "European" pigs at a large party which was controlled mainly by men. The event ran at a loss and the club became insolvent. The final measure of the lack of support by women in the club and their lack of confidence in their sisters was the election of a man to control the club's fading destiny. Thus the original objectives, at least in Gwelikum, were largely unmet and so of limited value (as with the MCH Clinic) as an extension service.

Translating a general impression of positive changes in child nurturing to more precise "evidence" or indicators is difficult, but a number of phenomena were observed which suggest a lowering of the critical age above which a child is regarded as an important entity. The tangible indicators of a shift in the nurturing paradigm are: the deliberate use of particular weaning
foods (both subsistence and store-bought items); the purchase and use of special children's eating utensils (designated bowls and spoons); the recognition of chronological age in the child, and with that, the celebration of birthdays in children as young as one or two years of age; the purchase of infant and toddler clothing; and the early creation (i.e., as early as 6-12 months) of savings bank accounts for the child's later education. In addition to these phenomena, other less tangible manifestations of a shift were noted also, and centred on the response by parents to illness in the child. Illness was attended to more quickly and in a consistent manner less influenced by competing demands for time (i.e., in normal circumstances, heavy garden work demands may take precedence over taking a sick child to the aid post). Fathers were also more prepared to assume some of the more routine child care duties.

There is no evidence at present that the various child nurturing changes will necessarily lead to a general shift in the Abelam nurturing paradigm. Indeed, I believe that although there appears to be an inexorable modernisation trend, there is a pervading atmosphere of rejection of many of its symbols and institutions (Chapter 3). In particular, the MCH clinic, the Women's Club, and the perceived uncaring Provincial and National governments (and their extensions) are major components of Gwelikum's disenchantment with its externalities. Although there is evidence of the development of a more appropriate "culture of nurture", the changes are not widespread and may be tenuous or transitory phenomena in Gwelikum.

7.8 Summary

A number of pre-contact Abelam nurturing practices appear to be responses to both high infant and toddler mortality and morbidity, and to subsistence labour demands on women. Arising from these responses are

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*Includes: purchased tinned infant foods, mashed or other softened subsistence derived foods, relaxation of prohibitions against animal derived foods.*
mechanisms institutionalising child management practices to ensure maximum 
energy conservation and economic viability at the family level. The nurturing 
"strategy" was one of "benign general neglect" until life chances improved. 
Low body weight as an Abelam cultural ideal in infants and toddlers is a 
rationalisation for this neglect strategy. Unfortunately, a "benign general 
neglect" nurturing strategy is poorly adapted to contemporary realities of 
mortality and morbidity and exacerbates malnutrition (the "objective" of the 
traditional strategy). Although there is evidence of minor change to the 
Abelam nurturing paradigm, the overwhelming impression is that the 
traditional pattern prevails, and indeed is an important variable in 
understanding malnutrition in under fives and in particular, the toddler sub-
group.
CHAPTER 8
SOCIO-ECONOMIC INEQUALITY AND NUTRITION

The previous chapters have focused on various aspects of child-environment relationships, particularly child-disease and child-family interactions as important factors in the causes of malnutrition of under fives. In this chapter, the focus shifts to family-environment relationships, and in particular socio-economic inequality between families. Such inequality may have important consequences on food supply and the capacity of the family to adequately nourish its members.

Subsistence agriculture provides most dietary energy and protein with store-bought foods providing a significant but minor contribution (Chapter 5). Hunting and gathering are now insignificant activities and consequently contribute little. Ceremonial yams, although spectacular and central to Abelam culture, contribute little towards sustenance. Their role is much more important in competitive exchange and the resolution of conflict. Accordingly, the following analysis of socio-economic inequality focuses on the subsistence and cash sectors and excludes detailed discussion of ceremonial yam production and hunting and gathering activities.

8.1 A summary of Abelam subsistence economy

Traditional subsistence systems have been comprehensively documented by Lea (1964) for northern Abelam and Wosera areas, and in general the present day Gwelikum subsistence system differs in detail not kind, from Lea's description. Discussion here is restricted to a brief summary of the general system and more detailed analysis of subsistence inequality and its relationship to nutritional status in under fives.
Plate 8-1: Garden scenes in Gwelikum, above, preparing to plant, below, ka killed by drought
Most families prepare and plant a new garden each year. There is considerable flexibility in land usage and garden sharing. Each garden contains several blocks or plots marked out by the garden operator. He keeps some blocks for his own family's food needs and allocates any surplus blocks to close kin, sub-clan members, or friends. The "rules" are very flexible.

Gardens are prepared in waves across the Maprik area, transcending culture boundaries in the region, with the first gardens planted in the west and north and the last planted in the east and south. This pattern probably corresponds to a spatial patterning in rainfall distribution and the onset of useful rains in the wet season (although good data for the region are absent). Although climate is the dominant control over the preparation and planting calendar, cash cropping requirements have contributed to a temporal shift in the pattern (see below).

New gardens are cut towards the end of the dry season (August-November) from secondary regrowth forest of variable-age fallow (Gwelikum has no primary rainforest). Planting is carried out mainly in the wet season (December-March). Site selection depends mainly on the stage reached in the fallow (Appendix H). All cultivable land is potentially a food garden, and thus forms part of the garden/long fallow system. Gwelikum's soils are remarkably uniform in structure - they are dark yellow-dark brown clays with very shallow A horizons, are subject to both waterlogging and to extreme cracking during dry periods.

Both men and women work in garden preparation, planting, maintenance and harvesting, although the tasks undertaken vary. It is difficult to quantify the energy expended by men and women in the various tasks but my conclusion is that the efforts of both sexes are approximately equal, but when child care is added, women undertake more than half of all work. Intensity of labour input also varies. Men, in general, undertake the most physically demanding tasks where strength is all-important. Many of the more tedious, time consuming and continuing duties are performed by women.
There is considerable overlap however, with some men performing "women's work" and some of the stronger women undertaking some of the heavier work (Appendix I). In general, the planting and harvesting of yams (except some varieties of *D. esculenta* planted by women in the swept ash piles) is men's work, and taro planting and harvesting that of women. The physically demanding task of carrying the harvest back to the yam house for storage is divided between men and women although the methods vary. Men carry the largest *D. esculenta* in sago spathes (*pangals*) on their shoulders whereas women carry the smaller tubers in their *bilums*.

Each of the three main types of garden (ie., "kitchen", "main", "asaakwa"¹ gardens) has its own system of internal organisation and preferred species and cultivars (Appendix J). Kitchen gardens are usually planted earlier in the wet season and although they are smaller versions of the main food gardens, the larger yam and banana cultivars are not usually planted. Occasionally, sweet potato may be planted in preference to yams in kitchen gardens. The main food producing gardens contain yams (*Dioscorea alata, D. esculenta*); taro (*Colocasia esculenta & Xanthosoma sagittifolium*); bananas (various *Musa* sp cultivars); sweet potato (*Ipomoea batatas*); maize (*Zea mays*); beans (*Psophocarpus tetragonolobus, Phaseolus lunatas, Vigna sesquipedalis*); edible cane grass (*Saccharum edule*); and the leafy greens (*Amaranthus* sp., *Abelmoschus manihot*). Sago (*Metroxylon sugu*) and breadfruit (*Artocarpus altilis*) are the most important non-garden staples and *Gnetum gnemon*, together with pumpkin leaves and tips (*Curcurbita moschata*) the most common non-garden leafy greens. Maturity times of the various garden crops vary from about 6 weeks to one year.

A rapidly declining practice is that of planting the *D. esculenta* cultivar *asaakwa* in recently harvested ceremonial yam gardens. The traditional

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¹The *D. esculenta* cultivar *asaakwa* is grown throughout the Maprik area although it seems to be more important in parts of the Wosera, particularly along river flats subject to occasional flooding and waterlogging. *Asaakwa* is reputedly able to tolerate some waterlogging, unlike other cultivars, and has led to speculation as to its role in permitting more intensive horticulture in the densely populated Wosera (Forge, in press).
practice was to plant *asaakwa* last, after the main food gardens had been planted. This was the equivalent of a kitchen garden but differed in that it was the last planted and the largest *D. esculenta* variety was planted. As these *asaakwa* gardens were mixed gardens, the temporal supply of various greens and tubers was broader. If a gardener planted all three garden types, the food supply would be staggered over a long period. For example, a kitchen garden may be planted in September, the main garden between December and February and an *asaakwa* garden as late as March or April. Such sequencing of garden planting is now rare in Gwelikum, with many families planting only main food gardens. This planting pattern produces marked variations in the food supply - with some crops absent at one period, then a sudden over-supply, then equally suddenly, disappearance of the food from the diet. This is particularly noticeable with quick maturing perishable crops such as *Amaranthus* sp., maize, and all legumes, although the slow maturing *Saccharum edule*, also a perishable crop, is abundant for a short period only.

The main food garden is the least modified type of food gardening system but Gwelikum gardeners are much more flexible with the re-use of the garden after harvest. After the main food garden has been harvested of its yams and taro, only *Saccharum edule*, pawpaw, bananas and possibly *Abelmoschus manihot* are unharvested. The gardener must decide whether the garden is to be replanted, and with what crops. A number of options exist. If the yam yields were good, it is likely that yams will be replanted in the same holes as previously used. If the gardener has decided to replant the old holes with yams, newly harvested and graded seed tubers are used (Appendix K). If the old garden is replanted with sweet potato or bananas, the gardener tends to be more flexible. Sweet potato is the most common second crop after yams and again, the old yam holes will be planted. Taro are rarely planted in the old yam holes, although this crop may be planted at very low frequency in the old garden. It is not usual for maize, *Amaranthus*
sp, or beans to be planted in old gardens because the yields are very low. It is very rare for a garden to be planted a third time, but if it is, sweet potato is the tuber crop.

When sweet potato is planted, the dense leaf cover quickly suppresses emerging grasses and shrubs, thus minimising maintenance. For yams to yield well in a second-year garden, the garden must be regularly weeded. If bananas are planted in the old holes, very little, if any maintenance is undertaken.

Planting of yams is a communal effort, often involving up to 50 workers, usually kin, fellow sub-clan members or friends. Normally, at these large communal plantings, large quantities of food, including rice and tinned fish, are provided by the operator of the blocks being planted. The planting of a large garden frequently means the end of that family's reserves of yams, taro and money, such are the costs of communal planting. Some plantings may be delayed for a short time while the owner amasses sufficient food stocks (sometimes obtained from kin) to feed the workers. It is virtually impossible to plant a large garden singlehandedly so the work group is the appropriate solution. During the planting season, there is much forward planning of planting days and most men and women know their work schedule for the following two weeks. Labour contributions are always reciprocated.

After a garden is planted, a number of tasks must be undertaken. As the yam vines sprout, long bamboo stakes are placed near the yam mounds. The stakes are placed near a dead, pollarded tree and if the season is a good one, the vines will reach the upper levels of the stake and perhaps the tree. The men cut, carry, and erect the stakes. With the exception of one variety of asaakwa of the species *D. esculenta*, all yam varieties are trained on to stakes. The asaakwa exception\(^2\) is usually allowed to grow as a sprawling

\(^2\)Some informants disagreed among themselves as to whether this asaakwa was different. Some considered that it was merely a matter of choice by the gardener as to whether the asaakwa was staked. One man said that his climbing asaakwa planted in 1984 came from a brother who had grown it as a prostrate type.
prostrate plant. If grown in this way, it saves on staking labour but ground
cover and other lower level crops cannot be grown. Both types of asaakwa
are planted in very large mounds, rather like those made for ceremonial
yams, and large seed tubers are used. In parts of the Wosera (eg., observed
in Bapmukum in August 1984), asaakwa are grown, decorated and displayed
in the same way as D. alata tubers are by the Samukundi dialect-speaking
Abelam. Apart from staking, the garden must be regularly visited to harvest
early crops such as Amaranthus sp, beans, Abelmoschus manihot, and maize,
and to keep weeds down. This work is done mainly by women.

Prior to the yam harvest, women weed then harvest the taro. When
completed, the yams may be harvested. Usually the gardener only, or
perhaps he and another man, harvests the tubers. Thorns and centipedes
make this work somewhat hazardous. If young children are with the men as
they dig the tubers, they may derive some nutritional benefit by catching,
cooking and eating the numerous large ground crickets (waaknakwaami)
found in the soil. Some people ignore these insects, others relish them. After
the yams are harvested, they are graded and transported by both men and
women for storage in yam houses which may be either near the garden or at
the home hamlet.

In the 1983-4 season the average period between D. esculenta planting
and harvest was 7.5 months. Asaakwa need 9-10 months. Although many3 D.
esculenta holes also contain D. alata which mature in 6 months, most
gardeners do not harvest the D. alata tubers for fear of the D. esculenta
thorns and of disturbing the D. esculenta which are still growing. Those
who do harvest the D. alata separately do so because of food shortage.

Garden Rhythms in Gwelikum

Every aspect of life in Gwelikum has a temporal rhythm. Some features

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3The frequency depends on the supply of small D. alata tubers. In some gardens, most holes
may contain both species; in others, perhaps less than 5 percent of holes. Most larger D. alata
tubers produced from these mixed-species holes are reserved for planting in ceremonial yam gardens
in the following year - the main food garden thus serves as a kind of "nursery" for D. alata
yams.
of life are governed by daily cycles, others by monthly cycles, but by far the most important recurring theme is the seasonal cycle. Traditionally, gardening, dietary taboos, sexual activity (and hence births), warfare, hunting, ceremonial life, house building, food abundance and shortage, children's games, and many other aspects of Gwelikum life were seasonal and in most cases there was a strict order of events which provided order, a concept of normality, and at the same time, diversity in village life. Apart from the occurrence of the particular phenomenon there were usually antecedent signal or leader events which contributed to the feeling of order and normality. It is a moot point as to the starting point of a cycle, but in Gwelikum, the events leading up to the planting of *mambutapwaapi* are usually taken as the start of the new cycle.

An example of the cycle is the series of events surrounding the planting of *mambutapwaapi* (the most important of the ceremonial yams) and the harvest of the first *D. esculenta* from this year's garden. Planting of ceremonial yams is the first task in the annual cycle and takes place soon after the previous *D. esculenta* crop has been harvested. When the *D. esculenta* are nearly ready a small bird known as *tsambitsang* (the ka bird) is seen in small flocks in the region. The faint but distinctive call signals that the *D. esculenta* tubers are ready to harvest. At the time of the harvest, the Kapok tree⁴ (*Ceiba pentandra*) is dispersing its fluffy seeds, although at the time of first flowering the long yams are starting to sprout. This means that the yams have reawoken (the term used by ceremonial yam growers), and that it is time to observe the various food and sex prohibitions. By the time the long yams are ready for planting, the *taun* (*Pometia pinnata*) tree is bearing fruit - it used to be said that a man would refrain from eating *taun* fruit until he had completed planting his long yams but that as soon as he had done so he would gorge himself on these

⁴Although the Kapok tree is probably a relatively recent introduction, it is now an indicator species of some importance since it is seasonally connected to ceremonial yam cultivation.
sweet fruits. Kaberry (1941a) also referred to the rising of *kwangral-mengral* (the Pleiades) in September as a season marker. In Gwelikum this is also true but of no consequence in initiating work. The various events surrounding the yam cycle in 1983-84 are shown in Figure 8-1.

The traditional rhythm still exists although there have been many changes, both major and subtle. Dietary restrictions have been dropped by most people although most prohibitions can be observed because some of the older people adhering to them. Although inter and intra-village fighting has stopped, Scaglion (1976) reported seasonal variations in conflict types related to ceremonial yam cultivation and the Abelam cultural requirement that conflict be minimised during this time. Gardening is still strongly seasonal, contributing to seasonal food supply problems. In Gwelikum at least, there is no longer a seasonal component to births (cf. Scaglion 1978) thus indicating the abandonment of many sex taboos during the ceremonial yam growing season.

**Possible changes to the gardening calendar**

Although the gardening calendar is still largely controlled by climatic factors, the labour requirements of coffee production seem to have resulted in a delayed food garden preparation/planting cycle. The evidence for a shift is persuasive but not conclusive because most evidence is of a circumstantial nature.

The seasonal "coffee flush" coincides with the traditional "lean period", and the ceremonial season which includes yam displays, various festivities and inter-village yam/pig exchanges. The Abelam seem to have been seasonally "pre-adapted" to coffee growing. Most preparatory work in coffee gardens prior to the harvest occurs during a lull in food garden work when men are not concerned about being near to their wives or other women. As the coffee ripens, the *Limbom* palm (*Cyrtostachys* sp.) starts shedding its large flower bracts which provide the main equipment used in washing, soaking and carrying coffee beans. Later still, the *Limbom* palm sheds the spent, woody
Figure 8-1: Yam cycle and related phenomena, 1983-84.
flower racemes which are kept and used as brooms for when food gardens are burnt and swept in readiness for planting. I doubt that coffee would have been accepted so quickly if the harvest coincided with yam garden preparation or with the time when men must avoid women or if the main equipment supplied by nature was absent. In 1983-4, 95 percent of Gwelikum gardens were planted between December-March (Figure 8-2).

Lea (1964) reported that Yenigo gardens were planted in all months (but with a slight peak in October-November) because of pressure from Government officers who were trying to eliminate the annual food shortage which was thought to be contributing to malnutrition in the area. Kaberry (1941a:346,350) reported that in the pre-war years, planting started in September, and continued until December or January. Some young men did not finish planting until February. Stapikum gardens were planted in the September-December period and all gardens were harvested during the dry season (Lea 1964). Gwelikum gardens are planted later than the Stapikum gardens of the early 1960s and from a number of visits to the Wosera area during 1983 and 1984, the Woseras now plant a little earlier than in Gwelikum, but why? There are rainfall related reasons (at least in part) for the various local planting timetables and there is a planting gradient from west to east and north to south. Gwelikum seems to be drier than neighbouring Apangai which is situated on higher mountain country to the north and Apangai plants 2-3 weeks before Gwelikum and Aupik villages. Towards Dreikikir (30 km west), gardens were prepared at least 2-3 months before those of Gwelikum in 1983 and 1984. Other than for Maprik town, the rainfall data are poor or absent, but it was clear that there are substantial local variations in rainfall - temporally, quantitatively, and in terms of reliability. The Wosera region is notorious for extended dry spells whereas at Maprik, only a few kilometres away, may experience average

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5 A complicated rainmaking technique was invoked during the local drought of 1983-84. The technique produced results within days much to the chagrin of the Christian catechists of the village. See Whiteman (1967) for a partial description of the technique used at the Wosera village of Saragum during a major drought in 1963.
Figure 8-2: Seasonality of garden planting, Gwelikum, Yenigo compared.
rainfall. A similar situation occurred in Gwelikum between December 1983 and February 1984. This is normally the wet season but an extended dry period began to affect food supplies (particularly leafy green vegetables), most of the creeks had dried up completely, and washing water was very scarce. Maprik had no such drought and received some very heavy falls during this time. Indeed, Department of Primary Industry officers based at Maprik were completely unaware of the drought which affected the Wora, North Wosera and Bumbita-Muhiang Census Districts.

Climatic factors do not appear to explain the apparent shift towards later planting of food gardens in Gwelikum. I believe that the requirements of coffee production have had the effect of delaying garden preparation and planting for two or perhaps three months. Direct evidence for this is lacking but it is reasonable to assume that the older Stapikum planting cycle was much the same as in the Gwelikum area (the two areas are alike topographically and probably have a similar rainfall regime). Garden preparation and planting is intensive, requiring male and female labour for some weeks. Coffee harvesting and preparation for sale is also very labour intensive and during fieldwork I did not see any families dividing their time between coffee and food garden preparation. The usual pattern was for the last coffee to be processed and sold before turning to ceremonial yam garden preparation and planting. During the early stages of ceremonial yam nurture a man must take extra care - female pollution is inimical to growth of these yams. A system of equal work responsibility has developed between the sexes in coffee processing and during the coffee season men and women work side by side in the gardens. No man will risk his status as a yam grower by being tempted by women during the early stages of ceremonial yam nurture. Informants stated that previously, they planted their gardens in an

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6 When the ceremonial yam sprouts in the grower's yam house, this signals the reawakening of the yam and that extra care must now be taken. The yam cannot be easily fooled as there are many animal, plant and spirit sentinels capable of informing the yam of the grower's misdemeanours.
intensive work spurt in the early part of the wet season and that during the
dry season, ceremonial activity, harvesting, and warfare occupied much of the
time.

Although the Abelam gardening and cultural cycle was well suited to
the adoption of coffee, they have had to make a few adjustments, the most
important being a delay in the preparation of food gardens. Little coffee has
been planted in the Wosera mainly because of land shortages and accordingly,
the pattern of food garden planting differs little from the traditional regime.
As for the apparent overlap of food garden preparation and coffee production
in the Dreikikir area, I can offer no explanation. More data are needed on
labour division, any possible lag between garden preparation and planting,
and possible seasonal differences in coffee maturity in the region. The role
and importance of ceremonial yams in the timing of garden planting may
also differ.

Thus, it appears that there has been a temporal shift in the gardening
cycle which has resulted in a later start to the preparation and planting of
the main food producing gardens. The reasons for the shift are arguable,
although I favour the cash cropping hypothesis as the explanation. The later
start to the gardening cycle may be of no real consequence however; the
former system may have been sufficiently flexible to permit such a temporal
shift without dire results. Certainly, any such shift that appreciably reduced
ceremonial yam yields and tuber sizes would have been quickly abandoned,
and since *D. esculenta* are also important indices of wealth and large stocks
seem necessary for insurance purposes, any change to the gardening cycle
with deleterious effects on the *D. esculenta* resource base would not be
tolerated.
8.2 Population growth, environmental quality and land adequacy

Although coffee growing appears to have altered the gardening calendar without ill effect, the rapid population growth of the Abelam (1980 Census enumerated 44,000, an increase of 58 percent since 1958-59) may have affected environmental quality, created or worsened existing land shortages, and consequently affected the subsistence base (see also Lea & Weinand 1971). Lea (1964:38) calculated overall population density at 41 persons per km². By 1980 this had risen to 59 persons per km² (Census data applied to Lea's calculated land area). Density is highly variable however, with parts of the North Wosera exceeding 150 persons per Km². Gwelikum's population density is higher than the overall Abelam average (Table 8-1) but does this suggest an emerging problem of land adequacy? Identification of the early stages of absolute land shortage is a vexing topic.

Table 8-1: Population densities, selected Abelam & Wosera villages, 1980.

<table>
<thead>
<tr>
<th>Details</th>
<th>Yenigo</th>
<th>Stapikum</th>
<th>Gwelikum</th>
<th>Gatnikum</th>
<th>Nerikum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (h)</td>
<td>469</td>
<td>141</td>
<td>807</td>
<td>224</td>
<td>330</td>
</tr>
<tr>
<td>Population</td>
<td>344</td>
<td>328</td>
<td>582</td>
<td>282</td>
<td>323</td>
</tr>
<tr>
<td>Density per km²</td>
<td>73</td>
<td>233</td>
<td>72</td>
<td>126</td>
<td>98</td>
</tr>
<tr>
<td>Hectares/pers</td>
<td>1.36</td>
<td>0.43</td>
<td>1.39</td>
<td>0.79</td>
<td>1.02</td>
</tr>
</tbody>
</table>

- 1980 Census

Source: Yenigo and Stapikum land area calculated by Lea (1964).


Gatnikum and Nerikum villages adjoin Gwelikum, and both villages, according to Gwelikum informants, are the remnants of decimated Wosera villages forced northwards through warfare. They are both land short, and in the case of Gatnikum, all of their present day land holdings are the result of one Gwelikum clan allowing the remnants to use their land. By 1984, a number of Gwelikum "big men" were discussing the need to resume the land
(through legal action) now occupied by Gatnikum. Although villages like Gwelikum and Yenigo have comparatively more land than many other Abelam villages, does this necessarily mean that their resource base is adequate for their needs?

During fieldwork, the issue of land shortage was frequently discussed. Numerous instances suggested that this issue was emerging as a problem, and would continue to do so in the future. However, land for subsistence purposes was said by most men to be adequate; the "real" problem was finding enough land for bisnis (cash cropping), both for individual and co-operative ventures. Two cattle projects started during the 1970s were the first attempts to rationalise land use (by aggregating smaller, separately owned plots) for income earning purposes but for a number of reasons, including perceived land shortage, these ventures have failed. Other attempts at large scale cash cropping have failed because of disputation over land within and between patrilineages, sub-clans or clans. Tensions over land thus seem to focus on the "loss" of good subsistence land to perennial cash cropping ventures; there is more flexibility with subsistence land usage, mainly because it is a short-term, non-alienating use of the land. Achieving the correct balance between subsistence and cash use of the land is the contemporary dilemma for many Gwelikum people.

Although land shortage and its implications figure largely in the consciousness of many people, very few consider that the large population increase (52 percent in Gwelikum since 1958-9) has had any significant effect on land or fallow quality. Most older people can chronicle the main environmental events of the previous 25 years but very few relate these events to population increase and the introduction of cash cropping. The major environmental changes which are widely recognised include the disappearance of the last primary rainforest on Gwelikum land; the local extinction of many larger forest animals such as the cassowary, the tree kangaroo, wild pigs, a large pigeon, the white cockatoo and the hornbill, and
the disappearance of some forest plant species of advanced secondary regrowth and primary rainforest; and the emergence of new and apparently enduring patches of *Imperata cylindrica* grass. Only very few people associate these events with anthropogenic changes in forest ecology. Some dismiss the fauna depletion as nothing more than over-hunting following the introduction of the shotgun. Undoubtedly hunting has played a role but is not the sole explanation. Table 8-2 reconstructs the hypothetical fallow periods for Gwelikum at different times. Cash cropping (rice growing) was practised in 1958-59 but as the area is unknown no value is included in Table 8-2. Total land area is assumed to remain constant, as is the minimum subsistence area required per person (1984 per person values used). Future cash cropping area projections are also based on 1984 per capita values, and the type of cash cropping is assumed constant.

The combination of population growth, and to a lesser extent, cash cropping, has dramatically reduced the hypothetical forest fallow, and in theory this will continue to fall in the future. Soil fertility declines as the fallow shortens but determining the fallow age where this becomes significant for maintaining subsistence yields is unclear. What is clear, however, is that unless research quickly identifies this for the Maprik area's soils and forest types, and unless a population growth policy is rapidly implemented, a subsistence problem will emerge as has been evident in parts of the Wosera for many years. This of course may not necessarily occur if cash incomes substitute for subsistence food production.

The question of overall land adequacy in Gwelikum is a vexing issue. The population growth factor cannot be ignored, and although the subsistence system at present shows only minor symptoms of stress, the future is very bleak indeed in terms of land adequacy, both quantitatively and qualitatively.

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7 In at least three cases, these species were the basis of traditional medicines.
Table 8-2: Reconstructed and projected forest fallows, Gwelikum 2.

<table>
<thead>
<tr>
<th>Details</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1958–9</td>
</tr>
<tr>
<td></td>
<td>2%</td>
</tr>
<tr>
<td>Population</td>
<td>141</td>
</tr>
<tr>
<td>Land area (h)</td>
<td>309</td>
</tr>
<tr>
<td>Density (n/km²)</td>
<td>46</td>
</tr>
<tr>
<td>Area/person (h)</td>
<td>2.19</td>
</tr>
<tr>
<td>Cash crop area (h)</td>
<td>Nil</td>
</tr>
<tr>
<td>Food garden area (h)</td>
<td>8.0</td>
</tr>
<tr>
<td>Cultivable land/person (h)</td>
<td>1.56</td>
</tr>
<tr>
<td>Annual req. per person (h)</td>
<td>0.06</td>
</tr>
<tr>
<td>Percent cultiv. land/person (%)</td>
<td>3.85</td>
</tr>
<tr>
<td>Time to use all cultiv. land (yrs) (3)</td>
<td>26</td>
</tr>
</tbody>
</table>

(1) 1994 projections based on 3 population growth rates. 1958–1980 rate was 2.4% p.a.

(2) By 1984, 9.5% of new gardens were prepared on land last used between 1963–5 for rice growing.

(3) This is the “theoretical fallow” period.
8.3 Subsistence inequalities and nutritional status

Participation in the subsistence economy is highly variable in Gwelikum. Some gardeners produce large food surpluses, others barely, if at all, meet their own family’s food needs. Is such variable participation due to reduced or restricted access to land and other essential resources (such as seed yams), or do other processes underlie subsistence inequality? The restricted access to land hypothesis postulates the land resource base as a limiting factor and that in the “struggle” or competition for land, some families will have restricted access and will become economically marginal. Even if the assumptions in this hypothesis are valid, a number of practical problems arise in testing it.

Land access - theory and practice

In principle, land is owned by the sub-clan and a form of usufruct tenure exists with patrilineages controlling the land (Lea 1969). However, the differences between land tenure theory and practice mean that quantifying ownership and hence access rights is almost impossible. Although land is inherited patrilineally, the practice of quasi-patrilineal inheritance (ie., inheriting land owned by a man’s mother’s father’s clan or sub-clan) is common. In such circumstances, the recipient changes his clan allegiance to that of the land-owning clan. In addition, garden operators can often use land owned by members of another clan (although this flexibility does not extend to land to be committed to cash crops). Finally, clan membership is very fluid, with some men regularly altering clan allegiances - some even adopting the maternal clan, a theoretical impossibility! The flexibility of Abelam land tenure can be viewed as a positive attribute which minimises the potential for inequality in access to land. Thus, testing the “family marginality” hypothesis based on measuring diminished access to the land base is not possible in Gwelikum, but given the considerable flexibility of land access practice, such marginality seems unlikely.

Planting stocks as a vital resource
Land access for subsistence gardens is not presently a problem in Gwelikum but what may ultimately determine a family's food garden area is availability of planting stocks, particularly *D. esculenta* yam seed tubers. The area planted to yams dictates the residual area available for other crops. For example, some seed propagated crops such as *Amaranthus sp.*, maize, and legumes are species which produce abundant seed, so in principal these species would rarely be in short supply, but the final area (and hence output) planted is a function of the supply of "seed" yams which are tubers reserved from the previous crop. *D. esculenta* is the main food yam species and requires a whole, undamaged tuber for replanting (unlike *D. alata* tubers which may be cut into portions with "eyes").

The supply of seed tubers is a function of several factors including the size of the previous year's garden, the success of the harvest, and the ability to reserve rather than eat the tubers. This in turn may be influenced, in part, by the availability of other foods which again may depend on access to these resources (e.g., sago). If the gardener has insufficient seed tubers for his perceived family needs he can either plant an inadequate (to needs) garden or obtain tubers from other, richer men ("big men"). In 1983-84, this latter option was exercised by a number of men (known as "rubbish men"), resulting in considerable seed tuber circulation. Some "big men" deliberately produce a large surplus knowing that a number of "rubbish men" will seek tubers. This of course establishes a future debt, but the two main "big men" involved do not expect return of the seed tubers, rather, they expect the "rubbish men" to be of general assistance to them when they become frail and find difficulty in maintaining their "big man" status. Most recipients were related directly or by marriage to the donors (e.g., father's brother; wife's father; wife's brother; wife's mother). Of the 406 blocks planted, 49 (12 percent) were "financed" by seed tuber allocations from "big men". This

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8 The seed tuber reserves of seven families were surveyed in October 1983 (method shown in Chapter 2). There was a positive correlation between stocks and garden area subsequently planted \((r=0.73)\).
at least hints at some form of resource limitation and hence marginality of some households, but it also reflects a flexibility in Abelam society which minimises subsistence production inequality between families, particularly related families.

In addition to the obvious wealth differences between "donors" and "recipients" of seed tubers are substantial differences in fertility, the full significance of which I am uncertain. The wives of the nine donor "big men" gave birth to a total of only nine children (mean per wife=1.00, SD=1.24) and five of these women had never given birth; the ten recipient families were significantly more fertile, with 55 born (mean per wife=4.58, SD=2.06). Although the donor "big men" have fewer natural or adopted children, the older children of the recipient families are frequently called upon as a labour source by the "big men". It is possible that lower fertility in "big men" families both facilitates their own creation or being (as women are not weakened by childbirth and lactation), and permits maintenance of "big man" status through abundant labour (achieved partly through distribution of surplus yams). Thus differential fertility as an independent variable in the creation of socio-economic inequality warrants further investigation.

In principle, both land and planting stocks are potentially limiting factors which could lead to economic marginality. In practice, marginality due to restricted access to the resource base does not arise. Yet economic marginality seems to exist in Gwelikum. The mechanisms are investigated in the next sub-section.

Marginalisation and exchange processes

The process of marginalisation is incipient but the mechanisms are very different from those presumed by the "access to resources" hypothesis. The destruction of all forms of competitive exchange has been of great significance in producing marginal families. The two extant mechanisms for reducing potential inequality (land use flexibility and seed tuber mobility) have operated to prevent marginalisation from occurring at the production level.
(the first hypothesis above). My alternative hypothesis suggests that "marginalisation" is occurring because of the breakdown of competitive exchange. The process affects distribution, not production. Competitive exchange formerly operated at three levels: the *gei-tscharbera* (intra-village exchange between *ara* or moiety); the *waapi-tscharbera* (inter-village exchange of pigs and ceremonial yams); and *vi-tscharbera* (hostile inter-village exchange). Each man had an individual exchange partner from the opposite moiety so men competed individually between moieties and collectively as members of their own moiety. The whole village (the two moieties combined) also exchanged ceremonial yams and pigs with Aupik village. From time to time similar exchanges were made with hostile villages. Thus the hostile exchange was an effective method of ritualising and defusing hostility. Many older men still euphemistically refer to ceremonial yams as *vi* (spears).

In a fully operational exchange system, all men are necessarily drawn into competitive agricultural production; not only of ceremonial yams, but also of *D. esculenta* (particularly at the moiety level) and pigs. The "rubbish man" too was drawn into the system, and although his relative position within society was probably little different from today, by definition his production output should have exceeded his own subsistence requirements. In a non-exchange system, competitive production between many individuals continues - the power and status of being a "big man" remain important and this is mainly achieved through wealth in yams. However, since intra-village exchange is now non-obligatory, a number of non-participating men adjust their production planning to perceived minimum subsistence needs only. This is fine if their planning is sound, but the regional climatic regime seems to demand the production of a surplus as a form of insurance against crop failure (Figure 8-3). Thus, the competitive exchange system was well adapted to the regional climatic limitations.

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9 Defined as meeting normal subsistence food requirements for the nuclear family and providing sufficient planting material for the following year.
Figure 8-3: "Big men", "rubbish men", and drought

<table>
<thead>
<tr>
<th>LEVEL OF SUBSISTENCE PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate</td>
</tr>
<tr>
<td>Minimum subsistence</td>
</tr>
<tr>
<td>Surplus</td>
</tr>
<tr>
<td>Large surplus</td>
</tr>
</tbody>
</table>

'Stripey' Year

- Present-day subsistence characteristics of population
- Former subsistence characteristics of population

- "Rubbish man" component of population
- "Rich man" ("big man") component of population
The term "rubbish man" (Abelam term ɔ́wɔ́wɔ́mbando) is widely used in Gwelikum, and although it has a loose derogatory meaning (eg., during an argument), it also has a more precise economic meaning - that of poverty, the inability to adequately provide for the family, and generally a low achiever. "Rubbish man" status is "achieved" either by choice or through circumstances. In Gwelikum, three brothers (reared in Madang) refused to grow ceremonial yams and planted the smallest possible _D. esculenta_ crop area, preferring sweet potato. They were adjudged "rubbish men" by other villagers because of their contempt for yam growing. Other men are "rubbish men" because they are simply less inclined to work hard or are less competent than the average man. Gwelikum has several such men - they and their families tend to be quiet and socialise less with others.

Some "rubbish men" may be physically impaired (or perhaps their wives are), thus limiting their physical capacity as subsistence gardeners. Epilepsy (or a disorder resembling it) affects a number of (mainly related) families in Gwelikum and Aupik. Sufferers are reluctant to climb trees for fear of convulsing and falling to their deaths. This inability has several important consequences. In men, tree pollarding or pruning during preparation of new food gardens is not possible nor is the collection of coconuts, breadfruit, and _taun_ fruit. Such a man would be severely limited in his ability to prepare a ceremonial yam garden - such preparation is usually a solitary task and reliance on possibly profane labour would be unattractive. His potential for "big man" status is thus limited. Women sufferers experience similar limitations but the gathering of _Gnetum gnemon_ leaves is also prevented, and in these circumstances, alternative harvesting arrangements must be made or other greens eaten. In one family, the head suffered from frequent epileptic attacks thus meaning that his wife assumed all arboreal duties. Extra work such as this places higher labour demands on already nutritionally stressed women. In a second, related family, the circumstances were similar except that the wife was a cross-cousin of her husband, and her own immediate
family contained sufferers. She too was reluctant to climb trees. Significant perhaps is that both families described owned the lowest number of productive coconut palms in Gwelikum and had not planted (at October 1983) new palms for future use. The low number of inherited coconut palms may reflect longer-term inherited epilepsy in these families. Thus physical impairment and its consequent handicap can restrict access to some food resources.

The competitive exchange system minimised the economic marginalisation of the less competent individuals within the village and effectively functioned as a kind of enforced self-welfare mechanism, although some marginal people (eg., epileptics) may not have benefited greatly. One "big man" remarked to me that competitive exchange literally forced the allegedly lazy and incompetent families to produce enough for their own needs. Similarly, some "big men" were fully cognisant of their role as economic saviours following the 1983-84 droughts (via seed tuber donations) to the more marginal village families.

The "minimum subsistence needs" planning strategy can continue to function only for as long as the "big man-rubbish man" relationship continues to be important. Although the "big man" may rescue the unfortunate "rubbish man" or another who has misjudged his needs, he is assisting him only to the extent of meeting minimum subsistence needs. In a sense, this modified system supports lower wealth status for a number of families and because of the unequal relationship generated, inequality within the village is maintained. If yams become less important to "big men" and wealth is primarily measured by monetary accumulation, then the "rubbish man" will be in a difficult position, because the "big man" will produce a smaller yam surplus, which will restrict the supply of seed tubers to others. At present, "big man" status is determined by both yams and cash. It is difficult to predict the future relative roles of both forms of wealth but I suspect that cash will become more important. When land availability and quality
become a crisis issue, the present day flexibility of land-owners concerning the use of their land may tighten-up or disappear, creating more inequality in economic status.

**Food gardens and child nutritional status**

There have been few overall quantitative changes in Abelam subsistence agriculture since the largely pre-coffee/cacao early 1960s (Table 8-3), although the degree of intra-village variation was considerable in 1984. The issue of low subsistence participation (per capita food garden area) as a possible indicator of economic marginality and hence reduced capacity to adequately nourish is considered in data presented in Table 8-4. Lea (1964:86) noted the wide range in the number of blocks per family. This was true also in Gwelikum in 1984. Garden size, blocks per family and per capita garden area in Yenigo (1961-2) and Gwelikum (1984) are not significantly different. The wide range in the number of blocks per family only suggests the possibility of unequal land usage and possible marginality, so a more detailed analysis is presented in Table 8-4. In this analysis Gwelikum families with under fives are divided into those with malnourished (below 80 percent of Harvard W/A standard) or well-nourished children. The family is defined as the nuclear family.

Although the mean area gardened by families in each group differed the differences were not significant, and further, neither group differed significantly from the village mean (SD) area per family of 2688 (1431) m². Gwelikum families, however, cultivate substantially more land than their Numamaka counterparts whom Ross (1984) reported cultivated 1400 m² approximately per family. Less land per capita is used for food production in families with malnourished children and the difference is statistically significant. This is in general agreement with Ross's (1984) findings for Numamaka village although the difference there was not statistically significant.

The stronger difference between Gwelikum malnourished and well-nourished families when compared to those in Numamaka may be due to the
Table 8-3: Yenigo and Gwelikum, food garden data, compared.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Gwelikum</th>
<th>Yenigo (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (m²)</td>
<td>122,775 (2)</td>
<td>112,381</td>
</tr>
<tr>
<td>Gardens (n)</td>
<td>63</td>
<td>48</td>
</tr>
<tr>
<td>Mean garden area (m²)</td>
<td>2230</td>
<td>2586 (4)</td>
</tr>
<tr>
<td>SD (m²)</td>
<td>1857</td>
<td>1214</td>
</tr>
<tr>
<td>Blocks (n)</td>
<td>406</td>
<td>465</td>
</tr>
<tr>
<td>Mean blocks/garden</td>
<td>6.44</td>
<td>9.7</td>
</tr>
<tr>
<td>SD</td>
<td>4.5</td>
<td>N/A</td>
</tr>
<tr>
<td>Mean blocks/family</td>
<td>5.8</td>
<td>6.8 (5)</td>
</tr>
<tr>
<td>SD</td>
<td>3.2</td>
<td>3.7</td>
</tr>
<tr>
<td>Resident pop. (3)</td>
<td>204</td>
<td>213</td>
</tr>
<tr>
<td>Area/person (m²)</td>
<td>602</td>
<td>528</td>
</tr>
</tbody>
</table>

(1) Lea (1964)

(2) Total area was 140,495 m² but some blocks operated by Aupik, Gwelikum 1, and Nindiko residents. Gwelikum 2 area shown above.

(3) There were 21 absentees included in Lea's original calculations. Excluded here for comparison purposes. No absentees in Gwelikum.

(4) Difference not significant
p > 0.05, (t=1.153)

(5) Difference not significant
p > 0.05, (t=1.735)
Table 8-4: Food garden area/person (m2), and nutritional status.

<table>
<thead>
<tr>
<th></th>
<th>Families with malnourished under fives (1)</th>
<th>Families with well-nourished under fives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of families</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Mean garden area/person (SD)</td>
<td>367 (179)</td>
<td>764 (290) (2)</td>
</tr>
<tr>
<td>Mean garden area/family (SD)</td>
<td>2207 (1425)</td>
<td>3118 (1397) (3)</td>
</tr>
</tbody>
</table>

(1) Malnourished defined as < 80% W/A
(2) Significant, p < 0.001, t=3.91, df=21
(3) Not significant.

presence of "error" factors in Numamaka such as differential sago use and extending the life of old gardens (Ross 1984:48-49). This labour (and sago) for land substitution however, is not complete in Numamaka mainly because of male absenteeism which has created labour stresses on women, that is, mothers of under fives, who in turn cannot process enough sago to substitute for reduced garden output (caused by land shortages). In Gwelikum, male absenteeism is almost non-existent, and in any event pre-pubescent and post-menopausal women only may process sago, so mothers of under fives are not burdened by these duties.

Neither Ross nor I were able to adequately quantify garden re-use as a significant type of intensification practised by some but not by others; however, most families in Gwelikum replant a garden or part of a garden. I do not consider the differential re-use of old gardens due to labour stresses to be a significant factor in Gwelikum, mainly because most gardens are replanted by men at harvest time, and replanting of yams is much less labour demanding than the preparation and planting of a new garden (although the weeding cost is high). In Gwelikum, overall mean garden area (ie., current year gardens only) planted per family in 1984 was 2688 m2;
Ross (1984) reported 1400 m2 (approximately) per family. This very substantial difference suggests that intensive garden re-use is vital in the Wosera. Over two years, the total area only just exceeds that for one year in Gwelikum. As most Gwelikum families also re-use their gardens (or part thereof) and do so without apparent labour stress, it seems unlikely that differential garden re-use due to labour stresses would be a problem in the Wosera.

Mothers of under fives are subject to health and nutritional stresses but the effects are mainly reflected in poorer child nurturing practices (and probably poorer breastmilk quality), rather than reduced subsistence labour inputs. Gwelikum men often help their sick wives on garden tasks but rarely assist with child care. Thus subsistence labour efficiency is not greatly impaired by illness and nutritional stress because of labour substitution, whereas nurturing capacity is impaired.

Further support for the incipient marginalisation hypothesis is that families with malnourished under fives received disproportionately more seed tubers from “big men” than did families without malnourished under fives. Six of the 10 recipient families with under fives had malnourished children, and represented 8 of the 11 children of the recipient families. I conclude that these families operated a minimum subsistence needs strategy, were adversely affected by drought, and were subsequently assisted by “big men”. Thus their planted food garden area included a “big man” “boost factor” which to some extent masks their real subsistence performance in the immediate past.

Therefore in Gwelikum, although an incipient process of “marginalisation” is evident, many traditional resource access practices sustain these marginal families. Should changes occur to these mechanisms which erode the “big man-rubbish man” linkages, it is possible that marginality may become inadequacy. At present, marginality and its nutritional effects are indicated by garden area data. The weakness of the garden area-malnutrition relationship as observed by Ross (1984) in the Wosera is
accounted for in terms of labour stress, particularly those stresses that fall on women. The chief causes of these stresses, namely, male out-migration and the inability of marginal families to boost sago production and intensify normal production - do not appear to be important in Gwelikum, and accordingly the relationship between food garden area and child nutritional status is stronger than in the Wosera. It is possible also that the 1983 and 1984 droughts sharpened the distinction between those on a “minimum subsistence needs” strategy and those seeking to produce a surplus. In a good year or series of normal years, the food garden area-nutritional status relationship may not be as apparent as the “minimum subsistence needs” strategy is adequate.

8.4 Drought and subsistence economy

A “minimum subsistence needs” strategy seems inappropriate in the variable climate of the Maprik district. A drought may shift many potentially marginal families into a state of real marginality. During 1983 and early 1984, drought had significant effects on yam harvests and on short-term supply of leafy green vegetables.

My arrival in Gwelikum (Sept. 1983) coincided with the end of a drought in the Maprik area. October to December 1983 saw the expected onset of the wet season, and once again, the normal seasonal rhythm was established. The rhythm was again severely disrupted by very low rainfall in January and February 1984. Rains in March were normal but an extended period of 31 continuous, rainy, overcast days in April and May 1984 created difficulties in subsistence gardens.

Some garden events

I was aware of two effects of the 1983 drought from an early time: the scarcity of mature coconuts and the very low *D. esculenta* yields. Some of the seed yam recipients were adversely affected by the 1983 drought. By late January 1984, it was clear that many *D. alata* were dying or had died.
Some men spoke of food shortages associated with drought, noting the severe drought of 1963, and to a lesser extent, 1978. In the 1963 drought, the *D. esculenta* harvest was affected and many *Gnetum gnemon* trees died back to ground level, bananas and *Saccharum edule* died, and no water was available for processing sago. Only one quality water soak remained in Gwelikum 2. Bananas in poorly weeded old gardens were said to have survived; those surrounded by bare ground died.

By the end of January 1984, very few bathing pools contained water, flies were very common and there was a noticeable increase in young children with scabies and tropical ulcers. The Aupik Aid Post even exhausted its supply of bandages because of the high demand. Early planted main food gardens were also suffering, particularly *Colocasia esculenta* and *D. esculenta*. During February, rainmaking magic was invoked. The magic involves the use of *waal'mb* (masalai penis), a phallic-like hollow stone which is stuffed with various plants and substances exhibiting obvious moisture traits. A complex set of songs, actions and prohibitions is associated with the ritual. The three main streams in Gwelikum 2 were dry and sago pulp was carried to the larger Yinam river for processing. Dead *Colocasia esculenta* plants were replaced with either bananas or a sweet potato cultivar which matures in 2 months.

During January and part of February, *Gnetum gnemon*, *Abelmoschus manihot* and pumpkin tips were scarce, but with the return of rains in March, these greens became more common. *D. esculenta*, however, did not recover, and by May 1984, it was clear that the *D. esculenta* harvest would be poor. Early *D. esculenta* harvests in July and August confirmed this. An analysis of yields of four *D. esculenta* cultivars from 104 plants, covering 4 gardens harvested in August 1984 revealed that yields for these cultivars were only half the comparable cultivar yields reported by Lea (1964). The Gwelikum yields were also substantially lower than those reported by Lea in the Wosera village of Stapikum (Appendix L). The Maprik market, which I
visited weekly, reflected most of the shortages and surpluses observed in Gwelikum.

Some responses to environmental perturbation

Most people were aware of the drought and its effects but considered that although the ceremonial yam harvest was unsuccessful, the *D. esculenta* crop would be productive. When it became apparent that virtually all main food gardens had failed, much discussion took place on the causes and cures. Of the causes, initially, lax adherence by women to menstrual prohibitions was cited but this was quickly dropped when reports of yam failures came from many other villages, including the Arapesh village of Ilahita to the west. One man claimed that *wai* (a type of garden sorcery) had been invoked by Apangai village. Once again, this was quickly dismissed as unlikely.

Another theory, discussed but not widely accepted, was that the fertile soil had left Gwelikum, and only poor soil remained. Soil is believed to physically rotate or cycle beneath the surface, behaving as a fluid. By mid-July 1984, a number of large gatherings were held in Gwelikum. These are known as *kum depato* or *kum denbandu* (clan, lineage or family gathering), or *yawinbangwu* (unification of family and garden), and were designed to openly air grievances, and to generally come to an understanding of the poor village economic predicament and what could be done to rectify the situation. One man claimed that the whole village structure was breaking down and that there was an urgent need to strengthen the community. Another man put it more symbolically:

"all the birds [people] that used to gather on Gwelikum land and eat aplenty; they scattered and disappeared when the trees [the economic base] fell down". Nukulak, "big man", August 1984.

This man was referring to the destruction of the economic base principally through abandonment of ceremonial yam beliefs and nurture; the divisions between families and the emerging individualistic, even hedonistic behaviour of individuals.
Although short on specific solutions, most agreed that it was time for the village to reunite and once again strengthen the economic base. This meant that competitive exchange would have to be revived. Just before my departure, four men purchased live piglets from visiting “Wosera entrepreneurs” in preparation for a future revival of inter and intra-village exchange. These events were contemporaneous with the events surrounding the opening of a new spirit house at adjacent Nindiko village. Although Gwelikum, as a village, had ceased competitive exchange some years before and many cultural events such as male initiation were thought to be thing of the past, some “big men” had maintained many traditions by associating with culturally active villages such as Apangai, Nindiko and Bainyik. In April 1984, two spirit houses were opened at Apangai. Many Gwelikum people attended, and became indebted because of Apangai hospitality.

At the same time, some of the traditionally oriented Gwelikum “big men” were assisting with the construction of a new spirit house at Nindiko. Nindiko had not built a spirit house since the early 1960s and were short of skilled artisans for the task. At the opening of the spirit house in July 1984, Gwelikum supplied most of the ceremonial baked sago and coconut slabs traditionally offered to visitors at the opening. This amounted to the felling of two large sago palms and the use of several dozen mature coconuts. By doing this, Gwelikum repaid its debt to Apangai (as many visitors came from Apangai), and in turn, Nindiko became indebted to Gwelikum. If Gwelikum builds its own spirit house in the future, it can call on Nindiko for assistance.

Another phenomenon at this time was a major fall in the number of practising Christians attending the Assemblies of God (AOG) church. Most younger people renounced the church in favour of the more interesting and

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10 One Wosera response to land shortages and the inability to grow much coffee includes pig husbandry for sale to Northern Abelam and Arapesh communities. Some Woseras exchange piglets for proven bandicoot hunting dogs - the dogs are used to catch bandicoots which are flushed from the extensive Imperata grasslands of the Wosera when they are burnt during the dry season.
exciting events taking place at Nindiko. As one man described this exodus from the mission,

"when the creeks are full of water, all the frogs sing loudly and long. When the creeks dry up, all the frogs run away into the bush in all directions. The singing stops" Wooranamini, "big man", July 1984.

An interpretation of events

I had to conclude my fieldwork in Gwelikum as the above events were unfolding so it is difficult to predict the long-term outcome. Some Gwelikum people wished to respond to environmental stress by invoking the traditional mode of production, a central feature being ceremonial yam cultivation, pig husbandry, and the revival of all forms of competitive exchange. It was long recognised by many "big men" that Gwelikum and Aupik needed to prepare many men for initiation but in 1984 no plans were evident. The environmental events of 1983-84 strengthened the resolve of "big men" to start a new cultural cycle which would start with the construction of a new spirit house at some future date. Most men considered, however, that Gwelikum did not yet possess adequate resources (food, pigs and labour) for this to occur, although the knowledge of the new Nindiko debt to Gwelikum made this a little more palatable. It is possible that the drought merely advanced the commencement of a new cultural cycle - an event which may have occurred anyway, but perhaps much later.

With the erosion (perhaps only temporary) of the Christian base within the village, many men considered that the way was now clear for a revival of competitive exchange, although the AOG mission was still strong in Aupik, Gwelikum's exchange partner.

In a traditional Abelam economy, the drastic measures proposed by a number of people would probably not have been necessary. This is because few, if any, families would be functioning on a "minimum subsistence needs"

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11The AOG church decrees that its members cannot attend "heathen" traditional ceremonies, cultivate ceremonial yams other than simply for food, smoke tobacco, chew betel nut, or take alcohol.
strategy. The former exchange system ensured a surplus, even by "rubbish men", this surplus objective being well suited to the local climatic regime.

8.5 Cash cropping inequalities and nutritional status

"Money is the white man's digging stick. Without it, how do you dig food from the white man's garden? You can only look and hope". Nukulak, "big man", August 1984.

In 1984, 10 percent of Gwelikum land was devoted to the perennial tree crops coffee and cacao. Family incomes in 1984 averaged 262 Kina (64 Kina per person), mostly from coffee. Income from other sources (eg., sales of vegetables and artifacts) was negligible. Coffee is seasonal and labour intensive and although most work does not interfere with subsistence gardening, I have previously argued that the subsistence calendar has been delayed by possibly 2 months or so to fully accommodate coffee. Cacao is not seasonal but as it is not labour intensive it was not a major consumer of labour (in 1984).

Coffee production is labour intensive and although there are some tasks more commonly done by women or men, labour specialisation is less marked than in subsistence gardening. Robusta coffee trees are planted at regular intervals under *Leucaena sp.* shade trees; grasses and forest regrowth must be regularly cut (both sexes); the coffee picked (both sexes) and transported to the stripping machine (mainly women); the "cherry" coffee soaked the the fruit stripped in a hand operated machine (both sexes); the wet beans rinsed then dried (both sexes); the beans bagged (both sexes), then carried to either the local village buyer or to either Lus Corporation on the Dreikikir road or to SPCA Ltd. at Hayfield (mainly men). Cacao is also planted under shade but the main task is to keep grasses down. Mature pods are easily harvested, split and shells discarded. The wet unprocessed beans are sold directly to the Cacao buyers who visit fortnightly.

The perceived shortage of adequate land for cash cropping ("functional land shortage" - Howlett 1980) has led to more rigid application of
traditional land access principles. In effect, a coffee or cacao garden must be planted on the land "allocated" to the man from his own patrilineage. Coffee gardens in Gwelikum are not established on a friend's land or other land such as a man's wife's father's land. The importance of the difference in access rules between subsistence and cash cropping is discussed in Section 8.6 below.

Coffee and **ka... a good marriage?**

Cash cropping, as a competitor for available land, has probably contributed to the shortening of the fallow period (by reducing the land for subsistence activities to 90 percent of the original area) but the overwhelming contributor to this is population increase, not cash cropping. I concluded above that the available data on subsistence agriculture suggest that cash cropping has had little quantitative effect on subsistence production. Certainly, there is no evidence of any overall "cash for subsistence substitution" (see Table 8-3 above).

Labour shortages sometimes arise during the peak coffee processing season but the shortages are of brief duration and not at the expense of subsistence activities (which are minimal anyway as it is the low work period between planting and harvest). Labour work groups comprising mainly adolescent boys and girls have emerged in response to the high labour demand at these periods of shortage. In effect, the "labour shortage" is culturally defined - there are no absolute labour shortages. Formerly (and to some extent today), adolescent boys would spend their time hunting or meeting girls during the quieter dry season months.

Cash cropping has not displaced subsistence gardens to inferior and distant sites. Indeed, the two activities co-exist on the same site types - this is almost inevitable because of the topography which is characterised by small ridges, moderate slopes and valleys. Apart from the sago palm filled valleys and the hamlets on the main ridges, virtually all of the remaining land is suitable for subsistence agriculture.
Variable participation in the cash economy

Although cash cropping may appear to be a general, uniform phenomenon in Gwelikum, participation in the cash economy is variable within the population (Table 8-5).

Most cacao was newly planted and not yet income producing. Coffee holdings were highest in the 21-40 year old age group but holdings were still significant even in the over 61 age group. Although new coffee plantings were still evident in 1984, they were minor when compared to cacao. New cacao plantings were more popular in the under 30 year old group although the cacao pioneers were the 31-40 year old age group (also the highest for old and new coffee). Older groups had little cacao. This shift away from coffee by the younger men will eventually spread income more evenly throughout the year as cacao production is less seasonal than coffee. The effect of more even income derivation on expenditure patterns and hence child nutrition is uncertain, but in principle, more consistent intakes of protein-rich foods such as tinned fish would be possible.

Cash crops for food crops?

The higher participation in the cash economy by the age groups with the most children (Table 8-5 above) begs the question "is this activity at the expense of subsistence production?". This issue is considered in Figures 8-4 and 8-5. The data do not support any "cash for food crops" substitution although they reveal that the 21-30 and 31-40 year age groups have the highest mean absolute cash crop holdings, and the latter age group the highest food crop areas planted. When the same data are considered on the basis of the mean number of persons (consumers) in the family in each age category (Figure 8-5), the area of both food and cash cropping declines substantially. This is because the 31-40 year age group has the highest number of consumers (naturally enough since it is the prime reproductive and parenting group). I suggest that although the food garden area per consumer is at it lowest for this age group, it should not necessarily be inferred or
<table>
<thead>
<tr>
<th>Age group</th>
<th>Mean no. in yrs.</th>
<th>Coffee</th>
<th>Cacao</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 20</td>
<td>1.6</td>
<td>198</td>
<td>980</td>
<td>108</td>
</tr>
<tr>
<td>21-30</td>
<td>3.3</td>
<td>2985</td>
<td>570</td>
<td>883</td>
</tr>
<tr>
<td>31-40</td>
<td>7.2</td>
<td>2804</td>
<td>1151</td>
<td>1727</td>
</tr>
<tr>
<td>41-50</td>
<td>4.5</td>
<td>2314</td>
<td>Nil</td>
<td>460</td>
</tr>
<tr>
<td>51-60</td>
<td>3.8</td>
<td>1928</td>
<td>Nil</td>
<td>645</td>
</tr>
<tr>
<td>&gt; 61</td>
<td>2.0</td>
<td>1467</td>
<td>Nil</td>
<td>Nil</td>
</tr>
</tbody>
</table>

(1) Family head, usually a man

(2) "old" means a mature garden

"new" means an immature garden
Figure 8-4: Mean total cash and food garden areas by age group, 1984, Gwelikum 2.
Figure 8-5: Mean cash and food garden area/consumer by age group, 1984, Gwelikum 2.
assumed that this level is below minimum subsistence needs. It is possible of course, that the level is determined by labour limits but it may also be that the level reached is still sufficient for both adequate food and planting stock levels. If the level is below minimum subsistence needs, then it would follow that malnutrition rates in the under fives should be highest in the 31-40 year age group. The mean age of family head in the "malnourished" families is 34.1 (SD=8.3) years, and in the "well-nourished" group, it is 35.7 (SD=11.9) years - virtually identical. Mean ages of their wives are virtually identical also (31.9 and 32.0 years respectively). In addition, although the mean age of malnourished under fives was lower (mean=26 months, SD=11.1) than the well-nourished children (mean=35 months, SD=18.6), the difference is not statistically significant. Similarly, the difference in mean number of consumers per family in each group (6.1 (SD=2.8) and 4.8 (SD=2.0) consumers respectively) is not statistically significant. Thus there is inadequate evidence to demonstrate that the food garden area planted by the 31-40 year age group is insufficient, and conclude also that the above evidence does not suggest any "cash for food crops" substitution process.

Cash crops and child nutritional status

Families with well-nourished under fives have more per capita land planted with mature coffee trees (and hence higher incomes) than do families with malnourished under fives (Table 8-6), and although the difference is statistically significant, it is not as marked as the differences in food garden area between the two groups.

The cash cropping/nutritional status relationship would be stronger if income as derived equalled purchasing power. In Gwelikum there is considerable non-nutritional use of money (Table 8-7) and there are often short-term mismatches between income derivation and consumption (Figure 8-6). In addition, a well developed credit system operates, although documenting the money flow proved to be a very difficult exercise.

A number of factors are involved, some of which relate to the
### Table 8-6: Cash cropping area/person (m²) and nutritional status.

<table>
<thead>
<tr>
<th></th>
<th>Families with malnourished under fives</th>
<th>Families with well-nourished under fives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of families</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Mean garden area/person (SD)</td>
<td>455 (296)</td>
<td>809 (388) (1)</td>
</tr>
</tbody>
</table>

(1) Significant, $p < 0.05$, $t=2.44$, df=21
Table 8-7: Expenditure patterns, 1983-84, Gwelikum 2.

<table>
<thead>
<tr>
<th>Expenditure Items</th>
<th>Amount spent (PNG Kina)</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beer (Oct 83-Sept 84)</td>
<td>6080</td>
<td>47</td>
</tr>
<tr>
<td>Rice (1785 kg @ 48t/kg)</td>
<td>857</td>
<td>7</td>
</tr>
<tr>
<td>Fish (913 kg @ K1.17 kg)</td>
<td>1068</td>
<td>8</td>
</tr>
<tr>
<td>Beef (52 kg @ K4.00 kg)</td>
<td>208</td>
<td>2</td>
</tr>
<tr>
<td>Misc. store items (1)</td>
<td>1462</td>
<td>11</td>
</tr>
<tr>
<td>Non-local expend. (2)</td>
<td>2500</td>
<td>19</td>
</tr>
<tr>
<td>Purchase of pigs from Wosera and other villages (8 @ K100 each)</td>
<td>800</td>
<td>6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>K12,975</td>
<td>100</td>
</tr>
</tbody>
</table>

(1) Includes: kerosene, soap, cigarettes, matches, towels, clothing.

(2) Estimated at K50/family/pa. Mainly items such as saucepans etc.
Figure 8-6: Monetary pathways in Gwelikum, a hypothetical example.

YEAR 1
'NORMAL' YEAR

COFFEE MONEY

NORMAL FOOD, CLOTHING, ETC

CEREMONIAL FOOD

BEER

DEBT REPAYMENT

RESERVES

CACAO MONEY

YEAR 2
SON MARRIES

COFFEE MONEY

NORMAL FOOD, CLOTHING, ETC

CEREMONIAL FOOD

BEER

BRIDEPRICE

RESERVES

CACAO MONEY

KIN CONTRIBUTIONS

YEAR 3
'NORMAL' YEAR

COFFEE MONEY

NORMAL FOOD, CLOTHING, ETC

CEREMONIAL FOOD

BEER

KIN RE SON'S BRIDEPRICE

CONTRIBUTION TO BROTHER'S SON'S BRIDEPRICE

NORMAL FOOD.

CLOTHING.

ET CETERA

YEAR 4
DAUGHTER MARRIES

COFFEE MONEY

NORMAL FOOD, CLOTHING, ETC

CEREMONIAL FOOD

BEER

KIN RE SON'S BRIDEPRICE

RESERVES

CACAO MONEY

DAUGHTER'S BRIDEPRICE

et cetera
"participants" or "players" and defining "money". Although Stent (1984) discussed many aspects of Abelam market economics, his analysis was a macro-level examination which provided little insight into micro-economic processes within villages. The term "money" and how it moves within the macro-economy is complex. Similar complexities exist at the micro-scale. A man's cash income soon undergoes a transformation, depending on his various obligations and perceived needs. Obligations concerning cash may be considered as follows:

- Obligations of self. These are the satisfaction of immediate, perceived wants or needs. The "income derivation-disposal cycle" is usually very short - a matter of days. Usually minor sums are involved.

- Obligations of non-traditional debt. These arise out of the credit system operating. The "debt initiation-income derivation-debt discharge cycle" may be as long as one year but usually no more than a few months. Amounts vary but are usually no more than K50-K200.

- Obligations of tradition. These are numerous, but money is now the most significant component of brideprice. The "debt initiation-income derivation-debt discharge cycle" may be as long as 3 or 4 years, many people may be involved in money transfers, and the sums may be very large, especially in brideprice transactions.

The results of a cash income and expenditure survey revealed that twenty two percent of all cash inflows were either repayment of debts or borrowed money. Of outgoings, 45 percent were debt repayments or loans given. As the survey covered only a one week period I expect that the ratio of income and expenditure to credit would vary over time, but nevertheless, credit is a major component of the local cash economy.

Income from cacao production was relatively low in 1983-84; sales were usually less than K5 per occasion. This money tended to be used to satisfy immediate family needs such as food or kerosene, and rarely became part of the "credit" or "traditional" monetary systems. In general, the larger the single income receipt, the greater the probability of it entering these latter systems.
Beer is important in Gwelikum expenditure patterns with 47 percent of income earned during 1983-84 spent on beer, and only 17 percent on rice, tinned fish and tinned beef. The proportion spent on beer could have been higher if not for the emergence of growth sprouts in mambutapwaapi ceremonial yams in late August 1984. "Big men" soon stopped drinking beer (i.e., beer is "female" and "cold"), and were closely followed by younger men. The money supply continued however, thus permitting a greater proportion of income to be spent on other items. A schematic summary of the "cash calendar" is shown in Figure 8-7. Beer is drunk by men only, and when this is added to the male share of other expenditure, about 75 percent of income is consumed by men. As they contribute only about 50 percent of labour, it is clear that women and children are disadvantaged by this expenditure pattern.

8.6 Summary and implications

Although the group of families with malnourished under fives planted smaller food garden areas per capita and had smaller coffee gardens per capita than the well-nourished group, there is little correlation on an individual basis between these two independent variables (r=0.41, r²=0.17). If the degree of correlation were much stronger, this would have suggested a similar underlying causal factor; the lower correlation lends support to my view that the pattern of the two variables is determined by different processes.

Broadly, I hypothesise that two separate processes are operating. Low participation in subsistence agriculture is due to processes of marginalisation, not to restricted access to the resource base. Low participation in cash cropping is due to stricter enforcement of traditional land access principles arising from increasing perception of land shortages. It matters little, for subsistence purposes, that a man has limited de jure land rights; a number of mechanisms ensure that inequality is minimised. Even with the breakdown
Figure 8-7: The coffee cycle and associated phenomena, 1983-84, Gwelikum 2.
of all forms of competitive exchange, the persistence of the "big man" system ensures that marginal families can function adequately (unless there is environmental perturbation such as drought) on a minimum subsistence needs strategy. On the other hand, access to land for cash cropping is determined by rigid application of traditional land access rules, without the flexibility which applies to subsistence agriculture. In Gwelikum, cash cropping must be undertaken on the operator's own land or land of his patrilineage. It is at this stage that problems of land access manifest themselves. Lea (1969) noted that when confronted with increasing and generalised land scarcity, the Abelam subsistence response was to restrict garden sharing, and gardens were prepared on the operator's own land or land from within the sub-clan. Thus, garden access practice approximated land tenure theory more closely. Lea's observations were made in the early 1960s, prior to widespread planting of coffee. At that time, rice was grown as an annual cash crop but as it merely mimicked subsistence activities it did not "alienate" the land for long periods, as perennial coffee and cacao do. Gwelikum's self-perceived land problems relate to land for cash cropping, not subsistence activities. Howlett (1980) referred to this as "functional land shortage".

If the above hypotheses are accurate, it follows that in villages or sub-clans within villages which were formerly not land-short but which are now beginning to experience stress, the first land tenure adjustments will show in relation to cash cropping - and perhaps in due course, when absolute land shortages emerge, the restrictions will apply to subsistence activities, and the relationship between nutritional status and subsistence activities will be even stronger. In areas with pre-cash economy land problems, restrictions operate in the subsistence economy (as described by Lea 1969), with other factors weakening the strong relationship between nutritional status and subsistence activities (Ross 1984).

Gwelikum has not yet experienced absolute land shortages, but with rapid population growth, the future is not assured. Severe environmental
events such as droughts reveal the weaknesses inherent in a "wound-down" system such as Gwelikum's which no longer collectively seeks to achieve surplus production. Larger numbers of marginal families are threatened with food supply problems when exposed to hazards such as drought.

The widely discussed impact of cash cropping on the subsistence base has been evaluated for Gwelikum and apart from a shift in the gardening calendar, no major negative consequences of cash cropping on the subsistence base are apparent. If anything, greater participation in the cash economy is associated with better nutrition in the under fives.
APPENDIX H

FALLOW STAGES IN GWELIKUM

<table>
<thead>
<tr>
<th>Samukundi Abe</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>term.</td>
<td></td>
</tr>
</tbody>
</table>

- **Isayawi** • Last year's garden
- **Waarayawi** • Very early stages of fallow. Short grasses and shrubs.
- **Tsoyawi** • *Saccharum* sp and *Imperata* grass, no trees.
- **Akiyawi** • *Saccharum* sp, *Imperata* grass, short-lived trees emerging.
- **Taliyawi** • As in Akiyawi but trees larger.
- **Apit'�awi or Ikniyawi** • Older secondary forest. Large trees and vines.
- **Wiyawi** • Permanent *Imperata cylindrica* grass in fallow.

* Continue producing food, mainly bananas.

The ideal garden site is cut from apit’�awi and certain indicator species should also be present. These are tsike and djimdjim, both species of Salaginella sp fern. Sites may be selected from akiyawi or taliyawi but the presence of *Saccharum* sp and *Imperata cylindrica* grass suggests low fertility and means extra preparatory work and ongoing weeding. If possible, therefore, these sites are avoided, as are very flat, stony, or excessively steep sites. Very steep sites are preferred for ceremonial yam gardens.
<table>
<thead>
<tr>
<th>Activity</th>
<th>Undertaken by:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men Mainly</td>
</tr>
<tr>
<td></td>
<td>Both Mainly</td>
</tr>
<tr>
<td></td>
<td>Women only</td>
</tr>
<tr>
<td></td>
<td>sexes women</td>
</tr>
<tr>
<td></td>
<td>women only</td>
</tr>
<tr>
<td>Garden Work</td>
<td></td>
</tr>
<tr>
<td>All ceremonial yam garden work</td>
<td>*</td>
</tr>
<tr>
<td>Slashing undergrowth</td>
<td></td>
</tr>
<tr>
<td>Cutting of trees</td>
<td>*</td>
</tr>
<tr>
<td>Pollarding trees</td>
<td></td>
</tr>
<tr>
<td>Log cutting &amp; preparing for burn</td>
<td></td>
</tr>
<tr>
<td>Firing garden</td>
<td></td>
</tr>
<tr>
<td>Clearing &amp; heaping debris for second burn</td>
<td></td>
</tr>
<tr>
<td>General garden cleaning</td>
<td></td>
</tr>
<tr>
<td>Final clearing &amp; sweeping</td>
<td></td>
</tr>
<tr>
<td>Fence building</td>
<td></td>
</tr>
<tr>
<td>Garden house building</td>
<td></td>
</tr>
<tr>
<td>Carrying seed yams</td>
<td>*</td>
</tr>
<tr>
<td>Breaking ground</td>
<td></td>
</tr>
<tr>
<td>Planting of yams</td>
<td></td>
</tr>
<tr>
<td>Carrying taro &amp; banana planting material</td>
<td></td>
</tr>
<tr>
<td>Planting of taro</td>
<td></td>
</tr>
<tr>
<td>Planting of other crops</td>
<td></td>
</tr>
<tr>
<td>Weeding</td>
<td>*</td>
</tr>
<tr>
<td>Yam magic</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Men only</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Making of trellises</td>
<td></td>
</tr>
<tr>
<td>Fence repairs</td>
<td></td>
</tr>
<tr>
<td>Harvesting of yams</td>
<td></td>
</tr>
<tr>
<td>Carrying large ka</td>
<td></td>
</tr>
<tr>
<td>Carrying small ka</td>
<td></td>
</tr>
<tr>
<td>Cleaning of ka</td>
<td></td>
</tr>
<tr>
<td>Grading ka &amp; storage in yam house</td>
<td></td>
</tr>
<tr>
<td>Harvesting other food crops</td>
<td></td>
</tr>
<tr>
<td>Carrying large firewood logs</td>
<td></td>
</tr>
<tr>
<td>Carrying firewood for cooking</td>
<td></td>
</tr>
<tr>
<td>Collecting water for cooking</td>
<td></td>
</tr>
<tr>
<td>Associated work</td>
<td></td>
</tr>
<tr>
<td>Collecting most forest foods</td>
<td></td>
</tr>
<tr>
<td>Cutting sago palms</td>
<td></td>
</tr>
<tr>
<td>Extracting &amp; pounding sago</td>
<td></td>
</tr>
<tr>
<td>Food preparation</td>
<td></td>
</tr>
<tr>
<td>All washing of utensils etc.</td>
<td></td>
</tr>
<tr>
<td>Feeding pigs</td>
<td></td>
</tr>
<tr>
<td>Killing &amp; cooking pigs</td>
<td></td>
</tr>
<tr>
<td>Hunting</td>
<td></td>
</tr>
<tr>
<td>Collecting breadfruit</td>
<td></td>
</tr>
<tr>
<td>Collecting &quot;tulip&quot;</td>
<td></td>
</tr>
<tr>
<td>Other activities</td>
<td></td>
</tr>
<tr>
<td>Cutting sago fronds for thatching houses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Men only</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Cutting timber for house frames</td>
<td></td>
</tr>
<tr>
<td>House erection</td>
<td></td>
</tr>
<tr>
<td>Road &amp; track repairs &amp; maintenance</td>
<td></td>
</tr>
<tr>
<td>Weeding &amp; sweeping hamlets</td>
<td></td>
</tr>
<tr>
<td>Most childcare duties</td>
<td></td>
</tr>
<tr>
<td>Transporting sick children to aid post or hospital</td>
<td></td>
</tr>
<tr>
<td>Manufacture of string bags</td>
<td></td>
</tr>
</tbody>
</table>

Note: the above is an expanded list of activities originally tabulated by Lea (1964:89, Fig. 15). Losche (1983:396, Fig. 9) has also modified Lea’s original Table, generally by adding women to previously male dominated tasks.
APPENDIX J

FOOD GARDEN TYPES AND INTERNAL GARDEN ORGANISATION

To a casual observer, the Gwelikum subsistence garden appears to have little regular form and organisation and in the absence of detailed knowledge of species' cultivars present, the quest for an understanding of the garden system would be futile. Many conventions, mostly subtle, exist in the average garden which give rise to a distinctive planting system. Apart from the waapiyawi (ceremonial yam gardens) there are two main types of normal subsistence garden. All families plant a numayawi (big garden) or kuluyawi (main subsistence garden) but some may also plant a maaknalyawi or takatu (kitchen garden). A very rare variant in Gwelikum is the taro garden which is usually very small, roughly prepared and often semi-shaded. It is usually a monoculture. The takatu contains only small D. esculenta and the normal range of other lesser vegetables. Large species such as bananas and Xanthosoma taro are also excluded. Formerly, most families maintained a takatu near their hamlet but most hamlets are now encircled by coffee or cacao gardens thus restricting convenient takatu site availability. The takatu, if planted, is the first garden planted and extends the temporal availability of greens, maize and D. esculenta.

The numayawi is the most important garden type in Gwelikum. This is the large, usually subdivided and shared garden. There are numerous conventions which are usually observed in planting sequence and spatial organisation of the garden. The order of the first planting is almost always as follows:

- tobacco, perhaps some Abelmoschus manihot
• most *D. esculenta* varieties
• taro, certain *D. esculenta* planted by women
• greens (seeds and cuttings), maize
• bananas, *Saccharum edule*, *Saccharum officinarum*
• *asaakwaka*

Most gardens are usually fully planted within a week although bananas and *Saccharum edule* may be planted sporadically over several weeks. Because these crops take about one year to mature, they are always harvested from the *isayawi*. The internal spatial organisation of the garden is most important - the main conventions are as follows:

• *D. esculenta* and *Colocasia* taro are planted at more or less even intervals (depends on the presence of tree roots and boles to some extent) but *D. esculenta* have higher densities. Densities were calculated at an average of 2600 holes per hectare. Larger *D. esculenta* seed tubers are planted at the rate of one per hole. Smaller seed *D. esculenta* may be planted at 2 or 3 per hole. Smaller *D. esculenta* tubers may be accompanied by small *D. alata* seed tubers. If small *D. alata* are planted they are usually planted in the same hole as compatible *D. esculenta*. The ratio is usually one *D. alata* to one *D. esculenta*.

• Large *D. esculenta*, such as *asaakwa* are planted on the moister, lower slopes of the garden, as is *Saccharum edule*.

• Smaller, and less moisture tolerant *D. esculenta* occupy the mid and upper slopes. In theory, different cultivars should not be randomly inter-planted as many are said to be incompatible. In practice, this belief is rarely followed.

• Wild yams (species, *D. pentaphylla*) found during garden preparation are treated as cultivated *D. esculenta*.

• Smaller banana cultivars may be inter-planted with *D. esculenta* and *Colocasia esculenta*.

• Larger, aggressive suckering banana varieties such as the introduced *sinalapu* (Cavendish) and *yawalapu* (Java or Sugar banana) are always planted as edge plants or even excluded from the garden.

• *Xanthosoma* taro is rarely inter-planted with *D. esculenta* and *Colocasia esculenta* because it is more vigorous, extending its roots widely. The Abelam claim that these roots, those of certain bananas and live trees from the adjacent forest, will “frighten” the *D. esculenta* plant and cause the tubers to withdraw. *Xanthosoma* is thus planted as an edge crop or on the lower
slopes if *asaakwa* are not planted. Occasionally, *Xanthosoma* may occupy their own small garden site.

- Crops which may be inter-planted include: maize, winged bean, lima bean, *Abelmoschus manihot*, *Amaranthus sp*, *Saccharum edule*, tobacco, *D. bulbifera*, and sugar cane.

- “Edge” plants include: sweet potato, cassava, cowpea, tomatoes, pumpkin, pawpaw.
APPENDIX K

D. ESCULENTA TUBER CLASSIFICATION

When harvesting D. esculenta tubers, they are graded into several types:

• Taakwika. The original seed yam, now shrivelled and spent. Of no use.

• Mingika. Tubercules, usually surrounding the main tubers. Of no use except as pig food. If no pigs are owned, they are usually thrown away.

• Numaka. The largest, most tender tubers. Usually at the centre of the cluster. Reserved for eating, usually as soup or peeled, cut and boiled. Men always carry these yams back to the yam house for storage.

• Nyamaka. Smaller than numaka but kept for consumption. Usually boiled or roasted whole. Carried by women in their bilums.

• Kandika. Superficially similar to nyamaka but is more fibrous. Is used for seed only. Distinguished from nyamaka by possessing more “hairs” on the lower portion of the tuber and when newly harvested, darker on the lower half.
### Yields of selected cultivars

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Number of holes</th>
<th>Mean (SD) no. tubers/hole</th>
<th>Mean (SD) yield in kg/hole</th>
<th>Mean yield in kg/hole - Yenigo *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kalamwei</td>
<td>66</td>
<td>5.04 (1.8)</td>
<td>4.76 (3.3)</td>
<td>9.86</td>
</tr>
<tr>
<td>Wilimala</td>
<td>19</td>
<td>3.74 (1.6)</td>
<td>3.73 (2.4)</td>
<td>9.42</td>
</tr>
<tr>
<td>Malata</td>
<td>11</td>
<td>5.27 (2.6)</td>
<td>4.8 (4.5)</td>
<td>8.5</td>
</tr>
<tr>
<td>Martka</td>
<td>8</td>
<td>5.25 (2.5)</td>
<td>2.69 (1.9)</td>
<td>6.44</td>
</tr>
</tbody>
</table>

Overall yield (SD) per hole = 4.03 (3.2) kg.
(127 holes weighed)

Overall yield per hole at Yenigo * = 8.96 kg.

" " " " " Stapikum * = 8.14 kg.

* Lea (1964)
CHAPTER 9
SYNTHESIS AND RECOMMENDATIONS FOR FURTHER RESEARCH

In this chapter, a synthesis of the underlying and contributing processes of malnutrition is made and some thoughts on intervention and further research are suggested.

9.1 Causes of malnutrition in Gwelikum

Although the preceding chapters have amply demonstrated that malnutrition in Gwelikum under fives is a function of many variables, the general causative processes are to be found in the child's micro-environment rather than as a result of inadequate production of subsistence foods. At present, there is no general subsistence crisis, although the contemporary subsistence economy has a number of potentially marginal or at-risk families whose food supply is threatened by environmental perturbations such as drought. Furthermore, an increasing perception of land shortage has resulted in restricted access to land for cash cropping, thus exacerbating economic inequality.

The child's micro-environment is dominated by two processes - pathogenic and maternal influences and controls. The precise nutritional history and circumstances of each child are the results of the cumulative child-environment transactions particular to that child - but what patterns or consistent themes emerge from an aggregation of all child (particularly infant/toddler) relationships?

General growth trends are readily described. Gwelikum children grow rapidly in their first six months but from 7 to 24 months or so, growth is poor. The 7-24 months period is one of "wasting" (declining W/L), but
eventually both W/A and W/L recover. Length for age (L/A) remains below the Harvard standard - it never fully attains the standard, thus reflecting longer-term "stunting". For some under fives, growth is not constant over time - indeed, the pattern of low growth rates at certain times of the year appears to be linked to fluctuations in food availability, food quality, and possibly fluctuating morbidity. Toddlers however, are less influenced by these factors ("seasonal" factors) and their growth tends to be uniformly poor over time.

A number of general statements can be made about the proximate factors which rapidly convert well-nourished infants into wasted toddlers, keep them wasted until at least 2 years, then gradually lead them out of a "wasted" condition to that of long-term mild "stunting". Dietary intake estimates (Chapter 5) show that \textit{prima facie}, energy and protein intakes (rather than metabolic or other physiological dysfunction) are insufficient to maintain adequate growth rates. In general, inadequate food consumption is not due to food production and supply problems - other factors in the child's micro-environment inhibit intake. Growth falters well before supplementary foods are first offered (mean age 8 months) thus strongly implicating this late introduction as a factor in the early and rapid W/L decline. Toddlers have the \textit{greatest variation in their pattern of regular dietary intake}. The immediate reasons for this are numerous and include: punctuated weaning behaviour; maternal illness, menstruation taboos, and tiredness which impair child nurture; illness-induced anorexia in the child with toddlers carrying the highest illness burdens; a suite of practical obstacles at meal times which result in poorer qualitative and lower quantitative intakes; seasonal variations in food types and their availability which alter the "bulk-density" characteristics and amounts eaten; the general restriction of higher quality foods until most deciduous teeth have emerged; and specific dietary restrictions during illness.

Proximate causal factors however, are merely the indicators of more
fundamental underlying phenomena. The **general** growth pattern of Gwelikum under fives generally and toddlers in particular is determined by three groups of underlying processes: the nature of the food resource base available to these children; the nature of the pathogenic environment, its resultant illness regime, and parental management of illness in the child; and the nature of the dominant child nurturing paradigm. The general growth curve thus reflects general patterns of dietary intake which are a function of the foods eaten (type and seasonal variation); and behavioural factors affecting qualitative and quantitative food intake (such as sickness experienced, how sickness is responded to, and the type of child nurturing). Why some toddlers are or are not malnourished at a point in time is thus a function of differential dietary intake - in turn influenced by more or less favourable illness conditions, nurturing behaviour and perhaps the foods themselves. This last factor refers to both food quantity and quality and reflects the family's socio-economic position within the village.

General underlying causal phenomena however, only explain the general growth curve. The wide range around the general population mean is ultimately due to different nurturing attitudes, foods eaten, and illness burdens experienced by every child. Better than average growth is achieved by some children but I believe this is mainly because of different nurturing attitudes and more effective illness management, and occurs in spite of the commonly eaten foods and illness regime experienced. A schematic view of malnutrition in Gwelikum is presented in Figure 9-1, and views malnutrition as the outcome of both **population** processes and **individual** child processes. In Figure 9-1, general population growth trends are linked to dominant cultural, resource, and environmental processes, whereas the specific growth features in each child are an expression of the variations around these dominant processes.

The three broad underlying causes of malnutrition in toddlers outlined above are each inextricably part of, or the outcome of the biotic and socio-
Figure 9-1: Schematic view of malnutrition in Gwelikum under fives

EXTERNALITIES:
- education level
- wage/coffee income
- MCH/Aid Post etc
- impact on parental attitudes

CHILD-ENVIRONMENT RELATIONS
AS THEY DETERMINE NUTRITIONAL
STATUS CAN BE CONSIDERED AT
THE GENERAL OR INDIVIDUAL LEVEL
(The example of W/L in toddlers)

EXTERNALITIES:
- acculturation
- market economy
- public health measures to control
  pathogenic risks

GENERAL
(dominant themes or
generalities)
- dominant socio-cultural
  and socio-economic themes
- pathogenic hazard risk
  and response themes

INDIVIDUAL
(processes underlying
variability)
- genetics
- chance
- parents' socio-cultural
  and socio-economic
  integration

EXPRESSION
EXRESSED AS:

THE GROWTH OUTCOME IN
INDIVIDUAL TODDLERS:
- differential health and
  response to treatment
- a range of nurturing experienced
- qualitative/quantitative
  differences in the food supply

EXPRESSION

EACH CHILD'S UNIQUE CIRCUMSTANCES
PRODUCES THE SCATTER ON THE GROWTH
CHART:

GRAPHIC REPRESENTATION

MAIN CHARACTERISTICS OF
TODDLER POPULATION:
- toddlers have lowest immunity
to illness
- "culture of nurture" applies
- "food bulk density" problem
  worst at this age

DOMINANT PROCESSES PRODUCE SHAPE
OF SYNTHETIC GROWTH CURVE:
cultural environments. The high sickness burden in under fives (especially toddlers) is a largely unavoidable load imposed by the pathogenic environment. In Gwelikum there are few sickness avoidance mechanisms; the response has thus tended towards the cultural incorporation or acceptance of morbidity and mortality risks and indeed has helped shape a distinctive nurturing system which nutritionally disadvantages infants and toddlers. Labour demands on women imposed by the culturally defined economic system have further assisted in the shaping of a distinctive, deleterious infant/toddler nurturing system. The food resource base presents special inherent difficulties to toddlers (ie., the "bulk density" problem), and this is exacerbated by seasonal variations in food bulk densities. The intrinsic bulk density problem is probably determined by the original availability of species and cultivars, but the seasonal variation in bulk density is both a function of climate and culture (although the seasonal dimension to culture probably arose from or was shaped by climatic controls over yam cultivation).

The identification of the fundamental causes of malnutrition in Gwelikum and the sources of variation in these causes should in principle provide the basis for an intervention strategy to reduce child malnutrition in the area.

9.2 Radical and conservative solutions - some comments and caveats

A central issue to resolution of Gwelikum's nutrition problem, by either radical or conservative means, is that of the perception of the problem. Gwelikum's "problem" is one perceived mainly by outsiders - no such "problem" exists in the minds of most villagers despite the diffusion of nutrition information throughout the district in recent years. Without widespread local recognition of a local nutrition problem, general responses are unlikely to arise.

For substantial improvements to the nutritional regime to be made,
major changes to the pathogenic environment, nurturing systems, and economic systems will be necessary. Past attempts to reduce disease burdens in the general population have been only partially successful and not all outcomes of the altered demographic processes (e.g., rapid population increase; continuing high morbidity levels) have been beneficial to the Abelam. Notwithstanding the apparent desirability and urgency of such radical intervention measures, a number of problems associated with intervention are apparent. First, radical measures are unrealistic in their capacity for development and implementation - for example, malaria control and eradication is still an elusive medical research objective. Second, the radical solutions are likely to initiate unintended and possibly negative social, cultural, and economic changes (see below). Third, externally conceptualised "problems" and "solutions" are a priori implicitly deemed to be superior response strategies, and as such do not either perceive or deny the value of fostering the development of locally derived solutions (see below also).

For the moment and for the sake of illustration, the following "solutions" to Gwelikum's nutrition problem are offered free of any social, cultural, or environmental consideration. As well as the requirement to reduce the disease burden of under fives, a number of other intervention strategies are necessary: the reduction of seasonal variations in food supply (which may involve staggered garden planting, continuous cropping, and altered land management practices such as the use of mulching); the reduction or elimination of the bulk density obstacle (which may mean developing appropriate village sourced weaning foods); and the reduction of labour demands on women to enable better quality nurturing (which may mean the development of non-swidden or extended life gardens, if that is possible).

Some of the preceding examples may appear feasible but child nutrition is not a discrete phenomenon independent of its social, cultural (and hence economic), and pathogenic milieu. Nutrition, as a sub-system concerned with who eats what and how much, is simply part of a larger socio-economic and
cultural system. The suggestion of specific intervention strategies however, to deal with specific elements of the child nutritional system is premature because although many cause-effect relationships may reasonably appear to exist and may have implied parameters, their full impact and significance in natural, uncontrolled conditions is unknown. A far from complete understanding of Abelam human ecology should be a warning against the manipulation of elements of a system in which linkages and directionality are unknown, and may have unintended consequences; and one in which unintended consequences may arise because of the inherent Abelam social and cultural capacity to change according to their own perceptions. Nutritional intervention measures, to be effective, require social and cultural engineering, questionable aims under any circumstances.

Unintended and possibly deleterious consequences may flow from seemingly socially benign intervention measures intended to redress child malnutrition. An example will illustrate. A presumed cause-effect relationship arising from my research findings is that low protein intakes in the “lean period” are associated with the strongly seasonal garden planting and harvest cycle. A remedial intervention would be to spread garden planting over a wider period, perhaps all months\(^1\). The intended effect is to make all foods available in all months, thus eliminating the extreme high bulk problem of the sago dominated “lean period”. In addition to the beneficial effects, some unintended consequences may flow. First, labour inputs needed to prepare more (although smaller) gardens may be higher than the present energy and protein returns to those providing the labour. The more consistent energy and protein flows may nutritionally benefit children but disadvantage adults, particularly women. Second, coffee production follows a seasonal cycle which is determined by natural not cultural factors. In these circumstances, and

\(^1\)In practice, properly staggered garden planting may be difficult to implement because of the demands of cash cropping. In pre-cash cropping years, the Administration was able to encourage planting in all months (see Lea 1964) but I believe that the demands of the present day dual economy have created an overall economic rigidity which would resist attempts to change the subsistence system. It may be possible however, to address this problem by focusing on kitchen gardens as continuous sources of minor vegetables.
those where food gardens were planted throughout the year, women may make less input to cash cropping (as men would opt for coffee processing and the consequent greater control over money, rather than food gardening). If men control an even greater share of income (at present about 75 percent), women and children will receive an even smaller nutritional share from the cash to store-bought foods conversion. Third, the destruction of the distinctive seasonal gardening calendar and its work group camaraderie may weaken social bonds within the village and even between neighbouring villages.

The last point needs some elaboration. At various points in this thesis, but in particular Chapter 8, the importance of the seasonal rhythm as a cultural and economic regulator has been stressed. Most subsistence activities, from the earliest stages of garden preparation through until the yam harvest, are characterised by a sense of common purpose throughout the village. This is especially so at planting time when large work groups assemble and plant the yams. During planting, the garden swarms with adults and children, and although the work is arduous, it is also a time of friendliness, reduced overt conflict, and heightened social intercourse. I am convinced that despite the drudgery, the social context of Abelam gardening is very satisfying for most people. I would be concerned that the reduction of subsistence activity to a formula suitable only for "proper" nutritional ends might lead to counterproductive results. A socially subverted culture (whose aims are subordinated to predominantly nutritional objectives) with well-nourished children may not be a satisfactory overall outcome.

The third in the trilogy of problems arising from radical solutions is the lack of due consideration by outsiders to the possible value of, or fostering of, locally derived solutions. Abelam society possesses two paradoxical features: an inherent cultural conservatism2; and a capacity to be innovative

2Apparently culturally moribund villages near Gwelikum such as Bainyik, Manje (Maprik village), and Nindiko underwent a cultural revival in the early 1980s with new spirit houses built and many male initiations held. In some cases, cultural life almost disappeared in the 1960s. In spite of numerous changes in village life, there is clearly a core of resilient cultural values.
and to experiment - for example, the comparatively recent *kumundji-kwiendji* moiety innovation which was spreading from east to west when Maprik was established in 1937 (Forge, in press). Thus innovation and experimentation were as much pre-contact phenomena as they are today.

In spite of an inherent capacity for innovation, Gwelikum’s younger people are less willing to experiment than their parents were. This may be partly due to Gwelikum’s unhappy economic history - one of economic promise unfulfilled (Chapter 3). Changing this pervasive despondency may be difficult and may be a barrier to the development of local answers to Gwelikum’s problems.

The capacity for change and the development of endogenous solutions to some of the “newer” problems is marred also by perception difficulties. Many Gwelikum people recognise that there has been a rapid population increase and that their physical environment has altered (particularly forest ecology and fauna diversity and abundance), but they do not link the two phenomena in a cause-effect way. The absence of a perceived link between increasing population and environmental deterioration provides a barrier, at least in the shorter-term, to the development of a local response to these dual problems. There is also an emerging awareness, at least by a few people, that child malnutrition is an abnormal and unacceptable condition - but this is only a dim and sporadic cognisance of the problem.

Other barriers to long-term endogenous solutions include the multitude of *ad hoc* phenomena which bombard Abelam society. The periodic intrusions of cargo cults, new *bisnis* ventures, *bisnis* failures, misinformation from government agencies (and misinterpretation of correct information), mission activities (and changes in missions), labour returnees, plus the legacy of WW2 - have all produced social and cultural “noise”, hindering the perception of problems and the generation of endogenous solutions.

Notwithstanding the larger obstacles to endogenous solutions, positive responses by a few people to the health and nutritional problems faced by
their children provide evidence of smaller, incremental social, cultural, and economic changes within the village. Perhaps the most realistic solutions to Gwelikum’s nutritional problems lie in attempts to shift behavioural and economic processes to the optimal or “better” end of the existing range of these practised phenomena. In effect this is incremental and gradual change, perhaps external in origin but internally or locally interpreted and implemented. It is a “passive pathway” to change rather than interventionist, externally imposed or forced development and modernisation. A “passive pathway” however, requires that the government agencies have effective extension services so that information and hence response options are possible in the village. Regrettably even a recommendation for “passive” change may be unrealistic given the deteriorating health and other government extensions in the Maprik area: “...the Health Service here is dying on its feet; standards of care are actually falling...” (Dr. Quentin Shaw, Medical Superintendant, Maprik Health centre; Pers. Comm. July 1986).

In conclusion, although there is a strong temptation to suggest fundamental changes to overcome the underlying causes of child malnutrition, any intended nutritional changes cannot be made independently of the social, cultural, economic, and biotic milieu in which nutrition is embedded. Despite much anthropological and other research, Abelam human ecology is not well understood and although the primary underlying causes of child malnutrition have been elucidated in this thesis, the full implications of the manipulation of major sub-systems may have unintended and possibly irreversible high social and cultural costs. This caveat should not be interpreted as an opposition to modernisation, which is an inexorable process in Gwelikum. Ironically, partial solutions to Gwelikum’s nutritional problems may lie in incremental behavioural shifts in individuals - a kind of modernisation filtered and evaluated through the socio-cultural lens. *Ad hoc* “solutions” which address only the proximate causes of malnutrition are bound to present problems. Thus although economic development is probably desirable (and is
perceived as such in the village), it is not the "magic bullet" and indeed may result in increasing economic inequality (the early signs of this are emerging in Gwelikum). The prospects for new economic opportunities are slight. The Maprik area economy is one of dependency and net loss to the region with most income from coffee and cacao exports, and virtually all goods imported. Similarly, the eradication of malaria will not cure the nutrition problem - it will certainly help, but corresponding changes to the dominant nurturing paradigm (a system which evolved in conditions of malaria holoendemicity) will follow only gradually. A change in the nurturing paradigm is crucial to a major improvement in the nutritional status of Gwelikum children. The suite of incremental socio-cultural changes must be accompanied by and assisted by a range of fully operational government extension services which should preferably operate within the social and cultural contexts of the client populations. In reality, re-establishment of the now moribund basic services at their former levels must be a priority and perhaps the most essential aim before even contemplating improvements.

9.3 Suggestions for further research

In the course of narrowing the focus on the underlying causes of malnutrition in under fives, many possibilities for further research became apparent.

The unfortunate economic consequences of the 1983 and 1984 droughts suggested that the contemporary subsistence system is inappropriate to the realities of the Maprik area climate (Chapter 8). The post 1960 period has been one of rapid socio-cultural change, and with that, some adjustments have been made to the subsistence and competitive exchange systems. Many families now operate on a "minimum subsistence needs" basis, an ill-conceived strategy given the climatic regime. The first major drought in the post 1960 period was in 1963, and at that time, I doubt whether most Abelam village subsistence systems had made the adjustments which are now widespread.
Since 1963 there have been few major droughts, so in many respects the new subsistence order is untested against the realities of Maprik's climate. Given the large population in the region which could be exposed to further nutritional stress when the next severe drought is experienced, research is needed to assess the capacity of contemporary subsistence economies in the region to respond to the various natural hazards, particularly drought. The focus should be the subsistence strategies of marginal families (and their linkages to other economic units) and how they are placed to respond to environmental perturbation.

Basic information is lacking about detailed nutrient composition (particularly amino acid composition) of Abelam foods, and accordingly, knowledge of optimal species combinations for enhancing protein complementarity is also lacking. This dearth of fundamental information about food composition should be remedied.

My exploration of Abelam child nurturing practices generated a number of hypotheses which should be further investigated. In particular, the hypothesised relationship between delayed Gross Motor Development and delayed weaning (and its probable vicious cycle) warrants attention, as does the nature of low body weight and infant/toddler passivity as desirable child traits in Abelam culture.

The different explanations offered for low participation in subsistence activities and low participation by some families remain as hypotheses. The practical significance of the "functional land shortage" (Howlett 1980) as it relates to land access for cash cropping should be investigated as a matter of priority so that the potential for even greater economic inequality than presently exists can be prevented.

There is a need for cross-cultural environmental perception research in environmentally stressed areas such as the Maprik District. Fundamentally different explanations are proposed by Gwelikum villagers for population increase and environmental change, and those perceived in this research.
Furthermore, the Gwelikum macro-view does not link population increase with environmental change - an obstacle to the generation of local consciousness (and from that, endogenous solutions) of population growth and related problems. Related to the previous issue is the need to identify critical or threshold soil and forest fallow conditions below which subsistence viability is threatened.
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